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Bids are being received by the Boston Transit Commission, as noted last week, for the first section of the subway, beginning in the Public Garden and ending at Park St. This section of the subway will take the street railways coming from Huntington Ave. and Boylston St. The cars will enter near the Tremont House, and pass around a loop and return through the subway. This arrangement is designed to relieve Tremont St. from its present congested condition. As we expect shortly to illustrate and describe this work in detail, we merely note at this time that the double-track subway is designed to be 24 ft. wide and 14 ft. high in the clear, and the four-track section is 48 × 14 ft., with a central row of columns. The subway is located near the street surface, and is to be built of steel imbedded in cement with brick arches between the beams. This first section will have about 5 miles of single track. This subway will be well ventilated and will be brilliantly lighted by electricity.

An armor-plate, made by a new process by the Carnegie Co., has been successfully tested at Indian Head. This was a 17-in. plate first treated by the Harvey process and then reheated and rolled down to 14 ins. in thickness. The first shot directed against it was from a 10-in. gun with a projectile velocity of 1,859 ft. per second. The point of the projectile penetrated 7 ins. and the shot itself was upset and broken into small fragments without developing the slightest crack in the plate. The plate was then fired at with the 10-in. gun with the charge used for testing 15-in. plate, with similar results. A 12-in. projectile, with a muzzle velocity of 1,858 ft.-sec., was later tried, and this shot bored a hole clear through the plate, but did not develop even a radial crack. As this latter was the official test for a 17-in. armor-plate, it is now declared by the press reporters that a way has been discovered for reducing the weight of armor by this re-rolling process after treatment, thus making a plate 14 ins. thick equal in resisting power to the heavier 17-in. plate. Further and more exhaustive tests will be required before this theory of weight reduction can be accepted by ordnance and armor experts.

Snow removal from the streets of New York is a possibility, as proven by the good work of Commissioner Waring; but it costs money to do it. According to the amounts already expended, about $135,000, and to the estimates of Mr. Waring, the single item of thoroughly and quickly removing the snow from all the streets below 42nd St. would amount to about $1,000,000 per year. Commissioner Waring says that it is entirely a matter of money; if the citizens will pay for clean streets, he can do the cleaning. If the Citizen Labor law were repealed, his estimate would be cut down about one-half, the difference in wages paid would be as 15 cts. to 25 cts. per hour. A contractor would also get more satisfactory labor out of his men, says Mr. Waring. To remove the snow from the whole city would cost about $2,000,000 annually, according to the commissioner's estimates.

The elevation of the tracks of the Galena Division of the Chicago & Northwestern Ry. in Chicago is ordered by an ordinance passed by the Chicago City Council Feb. 18. This line of the Chicago & Northwestern Ry. enters the city from the west, and the section to be elevated is approximately 1½ miles long. According to the ordinance, the elevated line is to cross all streets so as to give a clear head room of at least 13 ft. The streets at the crossings will be depressed from 2¼ ft. to 6¼ ft., the depression being generally about 3 ft. The full text of the ordinance has not yet been made public.

The most serious railway accident of the week was the derailment of a passenger train Feb. 23 on the Louisville & Nashville R. R., near Greenville, Ala. The train was filled with passengers for the Mardi Gras festival at New Orleans, and consisted of eight cars. The tender jumped the track, and the combination mail and express car, the smoking car and two passenger cars went down the bank. One person was killed and 8 were seriously injured, while 20 or 30 more were slightly injured by cuts and bruises. The wreck caught fire, and the wrecked cars, with two Pullman sleeping cars, were destroyed, only one sleeping car and a private car were saved.

A locomotive boiler explosion occurred on the New York & New England R. R. Feb. 21 near Danbury, Conn. The engine was hauling a freight train at the time. The fireman was badly scalded.

A horse car on the Chicago Lawn street railway was struck by a train at the Leavitt St. crossing of the Chicago & Northern Pacific R. R. Feb. 24. There are no gates at the crossing, and the conductor ran ahead and, seeing the freight train, signaled the horse car driver to stop. The latter claims that the horses were frightened by the train and became unmanageable. The engine struck the front end of the car, tearing off the platform and killing one of the horses. The driver jumped on the engine pilot and escaped injury. Of 10 passengers, 3 were seriously injured, and the others more or less cut and bruised.

During the recent very cold weather one of the three Jersey City water supply mains across the Newark marshes filled with ice to such an extent as to fail in some 40 lengths shortly after the weather moderated, according to reports. This main is of cast iron, 20 ins. in diameter; and the lengths which failed were at the Hackensack River crossing and between there and the point where the pipe leaves the marshes. The length of the pipe across the marshes is about four miles, and it is laid on the surface of the marsh, with little or no protection. The main was laid in 1854.

Bonds for extensive municipal improvements have been voted recently at both Allegheny and Pittsburg. A large portion of their proceeds are to be used for water-works improvements, as detailed in our "Construction News" in this and last week's issues. The total amount of bonds authorized at Pittsburg is $4,750,000, of which $2,000,000 are for water-works and the balance for parks, boulevards and other purposes. Among the water-works improvements are an increase of over 100,000,000 gallons in the pumping plant, a reservoir estimated to cost over $700,000, and new pipe lines. The Allegheny bonds will amount to $1,400,000, of which $400,000 will be added to sums previously authorized for water-works extensions, $500,000 are for street improvements, $300,000 for the condemnation and improvement of toll roads and $200,000 for sewers. It is proposed to spend nearly $400,000 for a filtering plant, but the matter has not yet been definitely decided. Bids will be received until March 14 for furnishing and laying a 60-in. steel riveted pipe, length not stated, for the Allegheny water-works. Mr. Robert McAfee is Director of the Department of Public Works.

A submerged crib for the proposed new water-works tunnel at Buffalo has been recommended by Mr. Edw. B. Guthrie, Assistant City Engineer. Mr. Guthrie has visited a number of lake cities for the purpose of studying their water-works intakes, and has decided that a submerged intake will be less liable to become clogged with ice than one extending to the surface.

Electric power to operate street railway cables is to be tried by the Chicago City Railway Co., according to the newspapers; and if it proves a success on the trial line, it is reported that all the company's cable lines will be run by electric instead of steam power. The first line of cable to be run by electricity will be a comparatively short one, and the power will be supplied from the company's large electric railway power house. A 600-HP. electric motor is said to have been purchased for the purpose of making the trial.

An ordinance providing for the elevation of the Pennsylvania Co.'s tracks in Chicago has been submitted to the City Council, and it is thought that it will be passed by that body and accepted by the railway company. The ordinance provides for the elevation of about 2.4 miles of track south of 54th St. North of 54th St. the company occupies tracks conjointly with the Chicago & Alton and Chicago & Western Indiana roads, and a general ordinance covering the three roads will have to be prepared. The present ordinance calls for an elevated embankment, with subways at the principal street crossings. There will be twelve of these crossings.

Elco gravel is a natural road-making material found in southern Illinois. According to a letter to this journal from Mr. A. E. Abend, City Engineer of East St. Louis, it is of a flinty nature, and when blasted it generally breaks up into a macadam or gravel size. It is stratified, and between the strata are layers of a silicious magnesia clay, which, after a short exposure, get very hard. When this gravel is put down and covered with this silicious clay and rolled, it becomes hard and compact, almost like a concrete foundation.

A car demurrage system for coal cars is to be adopted by some of the leading railways in England. Each merchant will be advised daily of the arrival of any cars consigned to him, and four days (exclusive of the day of arrival) will be allowed free of charge for unloading the car, so that a car arriving on Monday must be unloaded not later than the following Friday. After the four days, a charge of 12 cts. will be made for every day that the car remains unloaded.

Electric towing was introduced upon the Bourgogne canal, in France, on Aug. 20, 1893. This canal is 3.72 miles long, including a tunnel 11,100 ft. long, with a minimum depth of water of about 7 ft. Electricity, generated by turbines and operated on the overhead system, was substituted for steam towage at a total cost of about $27,000. According to a late report in the "Annales des Ponts et Chaussees," between Sept. 1, 1893, and April 1, 1894, the total traffic hauled was 80,794 tons in 897 working hours, at an expense of $1,180, including $60 for the use of steam towing during some slight repairs. During the same period in the previous year, using steam, the traffic was 78,639 tons, hauled in 917 hours, at a cost of $1,600. There was an evident saving in time and money by the use of electricity. For the transport of 1,000 tons, 11.65 hours and $20.40 were required with steam; and with electricity these figures were 11.01 hours and $14. While the time of service is too short to draw from it any very definite conclusions, the owners of the canal believe that the new system of operation will be profitable in the end.

The existence of the new element Argon appears now to be proved beyond doubt. According to the eminent physicists who have been engaged in its study, Argon has a specific gravity of 19.90 (that of air is 14.415). It is soluble in water to the extent of 4 volumes in 100. It boils at —187° C., and freezes at —189.6° C. It constitutes somewhat less than 1% of the atmosphere. Its most remarkable quality is its chemical inertness. So far every attempt to effect its chemical combination with other elements has proved futile, and it seems to be an entire anomaly in the chemical classification of the elements. The new element was discovered by Lord Rayleigh and Prof. Ramsay, and the discovery was first announced at the meeting of the British Association for the Advancement of Science last fall. Argon was first isolated from air by first removing the oxygen by passing the air over heated copper, and then causing the nitrogen remaining to melt with hot magnesium. Another method is to cause direct combination of the nitrogen and oxygen in the air by discharges of static electricity, the resulting oxides of nitrogen being absorbed by a solution of caustic potash.

A new smokeless powder known to the United States Ordnance Department as K-powder, is being made at the Newport torpedo station. Its chief ingredient is gun-cotton, and it has been kept for a year without deterioration. In recent trials at Indian Head it gave the great velocity of 2,495 ft.-sec. with a chamber pressure of only 15 tons per sq. in., with no flame at the muzzle, no objectionable gases and the residue in the barrel is neither excessive nor hard to remove. The reports upon it are so far exceedingly favorable.

A new system of great gun construction is proposed by Mr. Norman Wiard, a civilian ordnance expert of 30 years' standing. He advocates a radical change in the methods of rifling, in the shape of the projectile and in breech mechanism, and is applying to the Army Fortification Board for authority to put his ideas into pratice. His gun is to have but one rifling groove of proper twist contained in a removable lining tube; and he claims much less strain on the gun as resulting from this arrangement and less loss of powder energy in moving the projectile. He would also use a shot lenticular in section, presenting a minimum of shot surface to groove friction, and thus saving a resistance amounting in some cases to 60,000 lbs. and giving increased velocity to the projectile. He also proposes a method of ventilating the lower half of the gun, and thus allowing the escape of the excessive heat generated. He does this by drilling small holes in this part of the gun, which holes do not pass through the metal, but simply reduces its thickness in parts. Mr. Wiard asks that the government pay him $20 per ft.-ton of energy developed in excess of other guns in a ten-hour competitive trial, and claims that modern built-up rifles can be converted to his type of construction.

SPECIFICATIONS FOR STAND-PIPES.

By Prof. Wm. D. Pence.

Introductory.—In reviewing the many important matters suggested in my series of articles on "Stand-Pipe Accidents and Failures," which was concluded in the issue of Engineering News for June 7, 1894, the designer and builder of stand-pipes finds none which demands his thoughtful consideration more urgently than the enforcement of proper qualities of material and workmanship. The relation between this matter and the question of reform in this now important field of construction is, indeed, so intimate, and its bearing upon the duty of those responsible for the safety of this class of structures is so apparent, that the presentation of an outline of the tendencies of stand-pipe specifications at the present time seems to be warranted.

Owing to the comparative scarcity of matter relating directly to this subject, either in works of reference or in the files of technical periodicals and society proceedings, it has been necessary to a large extent to obtain facts and data through independent private sources. Among the authorities consulted for this purpose are a number of the more prominent stand-pipe designers and builders and plate metal manufacturers, dealers and consumers of the United States. Matter of much value was also obtained from recognized authorities in the field of structural tests. Much informaion of a valuable character and many sets of specifications of a recent date have been obtained with the understanding that the sources from which such matter was drawn should not be publicly identified therewith. Although personal acknowledgments cannot here be made, it would be unjust to omit the observation that those whose practice is distinguished by the most progressive ideas and methods are also most liberal and enthusiastic in supporting measures which tend to elevate the standard of quality in this field of construction.

An eminent authority has stated the legitimate functions of the specifications to be: "First, an effort on the part of the consumer to tell the producer what he wants; and secondly, it is of the nature of a contract equally binding both the consumer and producer to its provisions." Directing attention to the first of these functions, it may be stated as a recognized principle among good authorities that specifications for structural work should be not only so strict as to exclude all material and workmanship which does not meet the required standard of quality, but also so broad as to permit the use of all that certainly will not lower the adopted standard, the said standard being fixed in accordance with the true requirements of the case. Violations of this common-sense principle may usually be traced to ignorance of the conditions which may be imposed upon the structure, or of the qualities of workmanship and material which may be available or desirable for the specified purpose. Such misconceptions tend usually to a reduced standard of excellence through leniency, but the fact should not be overlooked that much harm may result also from the adoption of needlessly severe and perhaps impracticable requirements. By no means the least evil which may grow from the last-named tendency is the prejudice which it may entail upon the inauguration and prosecution of a reform. However, low-grade work is not the result of ignorance alone, for it is an unfortunate fact that dishonest motives not infrequently control either the preparation or the interpretation of specifications, and usually, if the former, also the latter.

There is much to support the assertion that stand-pipe specifications are frequently of too meager a character. Possibly this fault is a relic of the former custom with many users of wrought iron plate of specifying merely the trade designation of the metal desired, and providing that the tensile strength, brand, and maker's name be stamped on each plate. Whatever may be the cause or excuse for such deficiencies, either in quantity or kind of requirements, it is now conceded by most authorities in structural work that specifications should make distinct provision for adequate inspections and tests. Contemporaneously with the development of such a series of tests in other lines of structural work, the more progressive engineers engaged in stand-pipe design and construction have evolved a similar system adapted to the needs of that line of work. However, it appears that this development has in no important feature followed lines dictated by the behavior of stand-pipes themselves, but that it has merely kept pace with the evolution of methods and ideas in the closely related field of steam boiler construction. The details of the structural tests themselves have, of course, shared the modifications which have, from time to time, been made by the introduction and general adoption of the testing machine.

There are still a few engineers who favor the former quite prevalent plan of accepting the reputation of the maker, in lieu of the regular tests of quality. It is but simple justice to the high integrity of the product of a number of plate metal manufacturers to concede that the plates sent to the market by them, when of guaranteed brands, might be used in large quantities without the enforcement of the usual tests of quality with little probability of serious result; but, however desirable it may seem to makers of high reputation, that such a plan should be adopted, the present very natural demand for open competition has advantages which, in the minds of a large majority of those concerned, are sufficient to outweigh those of the plan referred to. The ideal plan from the standpoint of safety alone would, of course, be to choose the metal from the stock of a proven maker and then enforce the tests with full strictness for corroborative purposes. Such a system in effect is, and through an extended period has been, practised by a pioneer stand-pipe designer, who specifies that the steel shall be of "acceptable quality and manufacture." The above criticism of meagerness does not with justice apply to the practice of the engineer here referred to, although his specifications designate merely the elastic limit and the ultimate tensile strength required, in addition to the brief but comprehensive statement above quoted. Under the authority of the "acceptable quality," a set of detailed instructions covering a series of rigid tests, both physical and chemical, is issued to his inspector, who is required to return to him all test samples, with full certificates of the inspections and tests, which are preserved with much care. While the results attained in the case mentioned have been of the highest quality throughout, that fact does not altogether commend the omission from the specifications themselves of the detailed description of the required tests. With such omission supplied, the only criticisms, if any, to be made would come from either the consumer, who must pay for the privilege of selecting the maker of the plates, or the plate manufacturers whose product is shut out of competition. The engineer who adopts a system giving to him the power to select the producer, of course, imposes upon himself added responsibility, both as to quality of the metal and because of the usual imputation of dishonest motives in such practice.

Choice of Metal.—In weighing the relative merits of steel and wrought iron as materials for the construction of stand-pipes, it may not be denied that each metal has points of excellence possessed either in a less degree, or perhaps not at all, by the other. Judging alone from the recorded failures of the two metals in actual service, wrought iron appears to be preferable to steel. However, an entirely just interpretation of this record must recognize the fact that a majority of the total failures of steel stand-pipes may be traced to the use of ill-adapted or exceptionally inferior grades of that metal. With this qualification, the contrast in the records of the two metals is much reduced, if indeed it is not quite eliminated. Careful consideration of the foregoing records and facts related thereto leads to the following conclusions:

(1) That steel plate of cheap grades is certainly a dangerous material to use in the construction of stand-pipes.

(2) That steel plate of proper quality is a safe material for the construction of stand-pipes.

(3) That wrought iron plate, equivalent in quality to the usual grades of that metal hitherto employed for stand-pipe construction is a safe material for this purpose.

The first of these conclusions is substantiated by a number of the more widely-known failures of steel stand-pipes. The second is warranted by the scarcity of failures of steel stand-pipes, in whose construction proper grades of plate metal were used. The truth of the third is evidenced by the several classifications of accidents and failures.

The decided preference for steel, which has grown so rapidly in other fields of work, applies with full force in the construction of stand-pipes, and it has now reached such a stage that exceedingly few concerns make a specialty of building wrought iron stand-pipes. An important result of this evolution, which in the future may require a qualification of the third conclusion above stated, is thus described by a recognized authority in the field of structural tests:

> Steel for most structural purposes has so far replaced wrought iron that it is now difficult to get competition among the manufacturers of wrought iron for structural purposes. Many of the manufacturers who are still making wrought iron find that the demand is so much greater for steel—and in fact, the profit better in steel—that they are not putting the care and attention to the manufacture of wrought iron that they have in the past, and it is getting every month harder and harder to obtain the best grades of wrought-iron for structural purposes. There are, however, still a few concerns who are holding up their reputation and manufacturing as good wrought iron as in the past.

Another authority in the same field expresses the opinion that:

> The quality of wrought iron is about the same as it was before the "era of steel," but engineers and inspectors who have to deal with materials for structural purposes are no longer as familiar with iron as they were some time ago, or as they are with steel.

In view of the conflict of opinion indicated by the expressions above quoted, particular interest attaches to the following statement from a well-known firm of boiler-plate merchants, having an experience covering a period of more than a half century:

> There are very few mills to-day that have among their employees men who can make first-class iron, and by reason of the fact that orders for iron are so exceedingly rare and these men can be put at the work only at infrequent intervals, their skill has departed and they have no longer the ability to make as good iron as was made five or ten years ago.

Whatever be the present status of the question, it is pertinent to observe that the results of a very similar rivalry between steel and wrought iron in the manufacture of T-rails, some years ago, tends forcibly to confirm the belief that the quality of the superseded metal must decline sooner or later in the case under consideration. Such deterioration having taken place, it seems quite certain that wrought iron could show no superiority over steel in open competition, and, as remarked in discussing this subject at the conclusion of the original record of accidents, it seems altogether probable that the favorable showing of wrought iron indicated by the record of stand-pipe failures would soon be forfeited were the extensive use of wrought iron for this purpose to be suddenly resumed without a corresponding restoration of the former qualities of that metal. Fortunately, the few firms which have adhered loyally to the use of wrought iron and have built most of the large wrought iron stand-pipes during the period of alleged retrogression, seem to have recognized the importance of using good grades of that metal, so that the decline in safety, above suggested, has probably not begun.

Very naturally the reduced cost of steel, attended by a growing confidence in its uniformity and high quality when demanded, has led to a decided preference for that metal. That this preference will not be modified under present conditions seems very certain, but this fact will not, and very properly should not, prevent the use of wrought iron of appropriate grades when preferred. Since little assurance of excellence is to be found in the mere names steel or wrought iron, the really vital consideration is not so much which metal as what grade of the chosen metal.

Steel Plate.—The usual market grades of steel plate may be described as follows: Tank steel is the cheapest grade. Its low price is due primarily to the grade of stock used, giving a metal with high percentages of the detrimental elements, even without the careless manipulation which cheap work is so apt to receive. The quality of the tank steel produced by a few makers is sometimes quite good, but experience has shown it to lack uniformity, and good authorities generally agree in condemning its use in important structures. While

it may display the physical excellence of the best grades of steel, "it is apt to be hard and brittle and should never be used in any part of a stand-pipe." It is believed by some that a fruitful cause for the treachery of tank steel is to be found in the practice of selling under that classification steel plate which has been rejected from higher grades. It is common to find merely the tensile strength of this grade of steel specified, "60,000 T. S." being the usual requirement.

Shell steel is the next better grade. Its greater excellence and enhanced cost are due to the use of more care in selecting the stock and in perfecting the chemical nature of the finished product. Shell steel is used in ordinary boiler construction and many stand-pipes have been built from it. It is, of course, preferable to tank steel, but the best practice demands a better grade for high quality boiler and stand-pipe construction. A good authority states the following as a fair specification for shell steel:

Soft (preferably open-hearth) steel having a tensile strength between 55,000 and 64,000 lbs. per sq. in., an elongation in 8 ins. of not less than 20%, and a reduction of area at the broken section of not less than 40%. Specimens of any plate having a width not less than four times the thickness, when heated to a cherry red, and quenched in water, shall bend cold through 180° about a diameter equal to its thickness, without showing any signs of failure whatever.

Flange steel, the grade next above shell, is distinguished by its uniformity, high ductility and usually low tensile strength. It is the grade of steel plate adopted in the best practice for the construction of steam boilers and stand-pipes. Specifications for flange steel will be outlined in the discussion below.

Ordinary firebox and locomotive firebox are still higher grades of steel boiler plate, possessing special properties which fit them for the uses indicated by their trade designations.

The above general classes of steel plate are, of course, subject to variations which are common to such trade distinctions, so that the excellence of a low grade of steel of one maker is often greater than that of a higher grade by another maker's classification. The prices of the several grades of steel plate, on Jan. 1, 1895, are given in the accompanying table.

Prices in Cents Per Pound of the Usual Market Grades of Steel Plate, Jan. 1, 1895.

Grade of Steel.	New York.	Pittsburg.	Chicago.
Tank	1.25 to 1.40	1.15 to 1.25	1.35 to 1.40
Shell	1.40 " 1.45	1.30 " 1.35	
Flange	1.50 " 1.65	1.35 " 1.40	1.50 " 2.00
Ordinary firebox	1.75 " 2.00	2.50 " 3.75	2.00 " 4.50
Locomotive firebox	2.00 " 2.25	3.35 " 3.50	

Some stand-pipe specifications designate merely a minimum tensile strength for the plate. This practice is criticised because of the danger of cracking with high tenacities in steel plate, and it is the practice of a few engineers to provide especially severe ductility requirements for steel plate showing high tensile strength. By far the most common method of specifying tensile strength for stand-pipe steel is to fix a double limit, as in other classes of structural specifications. It is usual practice to fix these limits from 5,000 to 10,000 lbs. per sq. in. apart, the nominal strength of the metal being about midway between them. The elastic limit, when specified, is usually required to be at least one-half the ultimate strength, or a minimum value about equal to or somewhat greater than one-half the nominal strength of the metal is adopted.

There is lack of uniformity among stand-pipe designers in the matter of ductility requirements. Those engineers who lean toward boiler practice usually omit a specification for reduction of area at fracture, while those who adopt the methods used in bridge and similar metal structural work generally include requirements for both reduction of area and elongation. A controversy waged between the two has, in reality, had little foundation, since all agree that elongation is to be given the greater weight in judging of the quality of the metal, and those who advocate a requirement of a specified percentage of reduction of area do so only for the purpose of throwing additional light upon the subject, particularly when considered in connection with the character of the fracture. A well-known testing engineer remarks that he has often found samples of steel which have given ample elongation, but "in which the reduction of area was way below that which would ordinarily be required, and where the fracture showed crystalline and burned steel." The same authority admits the uncertainty which often attends the determination of the percentage of reduction of area in the case of wrought iron, because of obliquity of fracture. The advocates of the double designation have very wisely sought to select practical values for the two percentages from the results of extensive series of tests of the several grades of steel, and there is promise of quite general adoption of the values so determined. In these values the minimum percentage of elongation in 8 ins. is equal to about one-half that of reduction of area, the test piece to be as near ½ sq. in. in sectional area as possible. The following distinctive physical properties have recently been recommended by the most extensive producers of structural steel in the United States, and have received sanction in the practice of a large number of prominent engineers, including well-known testing engineers:

	Kind of Steel. Soft.	Medium.	Hard.
Tensile strength, minimum, lbs. per sq. in.	54,000	60,000	66,000
Tensile strength, maximum, lbs. per sq. in.	62,000	68,000	74,000
Elastic limit (compared with ultimate tensile strength)	½	½	½
Minimum elongation, in 8 ins., per cent.	26	20	18
Minimum reduction of area, per cent.	50	40	35
Cold bend test without sign of crack or flaw on outside of bent portion, diameter of curve in terms of thickness of test piece (to bend 180°).	(flat)	1	3

The above qualities for soft steel have been adopted in several recent stand-pipe specifications with the addition of a suitable cold-bend quenching or temper test.

The practice of varying the percentage of elongation with the thickness, recommended by the American Boiler Manufacturers' Association, in 1889, has been followed by several stand-pipe designers. The essential features of the "A. B. M. A. Standard Specifications" are as follows:

To be homogeneous steel made by the open-hearth process, and having a tensile strength of 55,000 to 62,000 lbs. per sq. in.; an elastic limit not less than 32,000 lbs. per sq. in.; an elongation in 8 ins. of 20% in plates ⅜ in. thick and under; of 22% for plates ⅜ to ¾ in., and of 25% for plates ¾ in. thick and over; cold bend test without signs of distress, for plates up to ½ in. thick flat on itself, and for plates thicker than ½ in. around a mandrel having a diameter 1½ times thickness of plate, 180°; to contain not more than 0.04% phosphorus, nor more than 0.05% sulphur.

Another method of varying the ductility requirement with the thickness of the plate is shown in the stand-pipe specifications of a prominent engineer who requires:

For plates ⅜ in. thick and heavier, elongation to be not less than 25% longitudinally on plate, and 22% transversely on plate. Plates thinner than ⅜ in., elongation to be not less than 22½% longitudinally and 20% transversely.

The same engineer specifies a phosphorous limit of 0.06%.

The cold bending test furnishes tangible proof of the ductility of the metal under conditions approaching those of actual practice, and the quenching test, when properly executed, gives evidence of the possible influence of local heating and working. These two tests are also credited with much value in detecting burnt and high-phosphorus steel, although an eminent authority, quoted below, states that steel containing an excess of phosphorus sometimes displays high ductility. The bending tests adopted for the steel used in a stand-pipe, built in 1894 by a prominent Western engineer, were as follows:

Specimens to bend cold, or after being heated to a cherry red and quenched in water at 70° F., on an anvil or in a testing machine, doubling the specimen and pressing it flat, without sign of fracture on the outside of the bent portion.

Another stand-pipe designer adopts the following provisions in relation to character of fracture and bending tests, from Cooper's "General Specifications for Bridges":

All broken samples must show uniform, fine-grained fractures of a blue steel-gray color, entirely free from fiery luster or a blackish cast. . . . Before and after heating to a light yellow heat and quenching in cold water this steel must stand bending 180° to a curve whose inner radius is equal to the thickness of the sample, without sign of fracture.

Other engineers designate quenching temperatures different from that above quoted, 80° and 82° F. being common values. The "Committee on Standard Tests," of the American Society of Mechanical Engineers, recommends a quenching test for boiler steel, "heated throughout to a dull cherry red (1022–1202° F.) and quenched in water of a temperature of 25° C. (77° F.)," after which the piece is bent about a stud practically 1-in. in diameter, regardless of the thickness of the sample, as in the German practice. Other specifications for stand-pipe steel fix the diameter of the 180° bend for quenching test at 1½ times the thickness of the sample, and this may be regarded as the most lenient requirement for thick plates that will give a fair assurance in relation to the quality thus tested.

The recent failure of a large steel stand-pipe has drawn attention to the fact that the specifications for the plate metal were grossly deficient in the matter of ductility requirements. Not only was there no reference whatever to either elongation or reduction of area, but the specification for a cold bending test was of an astonishingly deficient character. The provision referred to was as follows:

The metal of the plates must be . . . sufficiently ductile to admit of rolling while cold around a radius of 20 ins., without developing flaws, cracks, splits, or any other features which would render them unfit for the work in the opinion of the engineer.

That the defect was not accidental is shown conclusively by specifications prepared by the same engineer subsequent to the failure referred to, in which the radius of the required cold bend curve was reduced from 20 to 12 ins.

The practice of designating the process by which steel plate shall be made is in much favor with many prominent engineers and boiler-plate dealers of high reputation. One authority states that "the best grade of acid or basic open-hearth flange steel should be used for stand-pipe construction, since common Bessemer steel, which is generally more or less high in phosphorus and sulphur, is wholly unsuited for that purpose." It should be remarked, however, that the designation of the process alone may give little assurance of excellence, a matter which was recently discussed editorially in the columns of a trade journal as follows:

The terms "Bessemer" and "open-hearth" steels have reference to methods or processes, and not necessarily to qualities. If a good quality of pig iron is made into steel by either the Bessemer or open-hearth process, it would be found that the latter was softer and more uniform under the stress of severe usage. But Bessemer steel made of good iron is better than open-hearth steel made of a cheap and inferior material. Therefore the Bessemer tank steel of some manufacturers will run better than the open-hearth flange steel of other makers. The name don't make the quality.

Granting the wisdom of specifying the process of manufacture, strict consistency compels the adoption of chemical limitations. Phosphorus is properly regarded to be the most dangerous element in structural metal, and it is now comparatively common practice to designate a phosphorus limit even where no reference is made to the process of manufacture. According to Howe:*

Phosphoric steels are liable to break under very slight tensile stress if suddenly or vibratorily applied, or shock-like. . . . Phosphorus diminishes the ductility of steel under a gradually applied load, as measured by its elongation, contraction and elastic ratio when ruptured in the ordinary testing machine; but it diminishes its toughness under shock to a still greater degree, and this it is that unfits phosphoric steels for most purposes. The influence of 0.01% of phosphorus is perceptible—that of 0.20% is generally fatal in ingot metal. . . . The effect of phosphorus on static ductility appears to be very capricious, for we find many cases of highly phosphoric steel which show excellent elongation, contraction, and even fair elastic ratio, while side by side with them are others produced under apparently identical conditions, but statically brittle. . . . And it appears reasonably certain, though exact data sufficing to demonstrate it are not at hand, that phosphoric steels are liable to be very brittle under shock, even though they may be tolerably ductile statically.

The fact last quoted from so authoritative a source affords a most potent argument in favor of the adoption and rigid enforcement of a proper phosphorus limit for stand-pipe steel; for, while the physical properties indicated by the faithful execution of the usual structural tests will, in a majority of cases, reveal the presence of an excess of phosphorus, the possibility of selecting samples of a particularly ductile character, as above suggested, is very obvious. A testing engineer of ripe experience discusses the amount of the phosphorus limit as follows:

It has been found that while some good steel has been made that has stood splendid physical tests in every way with over 0.08% phosphorus, at the same time, where the quantity of phosphorus runs over 0.08%, the amount of defective steel is very rapidly increased. For such purposes as stand-pipe plates I certainly recommend that the requirement for phosphorus be even lower than 0.08%, namely, a maxi-

*"Metallurgy of Steel," pp. 68-9.

mum of 0.05%. . . . For ordinary stand-pipe steel, I would say to have a requirement of not over 0.08% of phosphorus; for best grades, a requirement of not over 0.05% phosphorus.

Some light is thrown upon the question of availability of good grades of steel for stand-pipe construction by the following statement, obtained from a steel-plate manufacturer of high reputation:

We have made everything from ordinary tank steel up to a fine quality of boiler steel for stand-pipe construction. While an ordinary steel may meet almost any physical specification very nicely, it is inclined to be brittle, and we do not deem it good enough for stand-pipes. Of late we have furnished quite a number of stand-pipes which call for steel to show below 0.06% phosphorus, and this we think a very good grade. . . . To our minds, a steel showing 55,000 to 62,000 lbs. per sq. in. tensile strength, 26% elongation in 8 ins., 50% reduction of area, and 0.05 to 0.06% phosphorus, would make an excellent stand-pipe, and, at the same time, would not be a very expensive grade of steel, although it would cost considerably more than common tank steel.

A recent proposal for the construction of an important stand-pipe in a Western city included bids according to five limitations for phosphorus, running from 0.08 to 0.04%, inclusive. The relative bids on the superstructure for the several grades of steel, taking that for the highest phosphorus limit as unity, were as follows:

Phosphorus limit, per cent.	Relative bid.
0.08	1.00
0.07	1.03
0.06	1.08
0.05	1.17
0.04	1.23

The plates were to be "soft, acid, open-hearth steel," of 54,000 to 62,000 lbs. per sq. in. tensile strength; elastic limit, 31,000 lbs. per sq. in.; minimum elongation in 8 ins., 26%; minimum reduction of area, 50%; cold bent flat; and not more than 0.08% phosphorus, and less per cent. as per detailed bid.

There is lack of uniformity in the number of tests required for the plate metal. Many engineers do not state the number in the specifications, but include that detail in the special instructions to the inspector, or leave the matter to the judgment of the inspector. It is the custom of a well-known testing concern to require at least one complete test of each open-hearth melt or Bessemer blow of steel, and to require each melt or blow to be kept separate and the number stamped on each plate; also to require, in addition, one test for each widely-varying thickness, in which this melt of steel may be rolled, and a test for each widely-varying difference in the treatment of the steel in the rolling or other operation in its manufacture. It is deemed wise to adopt some such basis as the above, as it "will give the inspector a right to require a test if he thinks that an ingot has been overheated, or anything of a similar nature." One stand-pipe designer, who has maintained a high standard of quality through many years, requires that "the test specimens shall, in all cases, be taken from the shearings of at least 20% of the plates produced from each melt, the plates or sheets to be selected at random by the inspectors." Others base the number of tests on the different thicknesses of plate required in the work.

In fixing the character and extent of the tests which are to be imposed upon plate metal, it is of the first importance to determine the method by which they are to be enforced. It is the practice of a few engineers to specify that the tests shall be made by the contractor or by the manufacturer, but the best authorities favor independent tests by competent and impartial specialists in that line. To this end it is conceded by foremost authorities in this and other classes of structural work that the maximum attainment of high quality, and hence of safety, is found in the employment of one of the several testing bureaus or laboratories of recognized integrity, which are now accessible to any part of the country. In addition to the tests made by such concerns, usually executed at the mills, it is the custom of several stand-pipe designers to require the contractor to furnish a series of certified samples, in order that corroborative tests may be made by the engineer personally. Others require that the testing engineer, in giving certificates of the behavior of the metal during test and of its chemical nature, shall return the tested samples, with proper identification to aid in their interpretation. It should be stated that the foremost practice in stand-pipe construction regards with the highest favor the prescription and faithful enforcement of such measures looking to the elevation of the standard of safety in the completed structure.

Wrought Iron Plate.—The several market grades of wrought iron boiler plate are described as follows:*

Tank iron is the cheapest grade and is used only for the most unimportant purposes. Refined iron is used when strength and toughness are not specially demanded, and where no risks are involved. Neither of these grades should be used in boilers or in any structure of great magnitude or value. Charcoal No. 1 iron (C. No. 1) has a tenacity exceeding 40,000 lbs. per sq. in., is hard, but not very ductile, and is never used when flanging or considerable change of form is required, as it is apt to break at the bend. Charcoal hammered No. 1 shell iron (C. H. No. 1, S.) is a better worked iron than C. No. 1; but it is not always hammered. It is stronger, having a tenacity of 50,000 to 55,000 lbs. per sq. in. in the direction of the fiber, and 75 to 80% of this amount across the grain. Although distinctly made for the shell of the boiler, the best makers generally prefer to use better grades for that purpose. A better quality known as flange-iron (C. H. No. 1, F.) is much more ductile and may be worked into flanged sheets; it is nearly equally strong in both directions and has about the tenacity of the preceding. Other higher grades such as flange fire box (C. H. No. 1, F. F. B.) are made for special purposes.

The following standard specifications for flange-grade iron used by the Baldwin Locomotive Works (Jan. 1, 1893) illustrate the qualities of wrought iron which may be secured at the present time upon proper inspections:

All boiler iron plates are to be of C. H. No. 1 flange quality, and to be made from best charcoal iron blooms. A careful examination will be made of every plate, and none will be accepted that show mechanical defects. A test piece, 1½ ins. wide and 24 ins. long, to be furnished from each plate rolled. No plates will be accepted whose test pieces show an ultimate tensile strength, with the grain, of less than 50,000 lbs. per sq. in., or less than 45,000 lbs. per sq. in., across the grain, or whose elongation falls below 20% in a section originally 2 ins. long. A drifting test will be made of at least two test pieces from each shipment, and no plates will be accepted which will not permit of a 1¼-in. hole being drifted out to 3 ins. diameter. Any plate which develops defects in working will be rejected. Each plate must be stamped with the maker's name, brand of the iron, and the guaranteed tensile strength.

Owing to the limited extent to which wrought iron has been used in the construction of stand-pipes for some years past, the collection of specifications for wrought iron stand-pipes of recent date has been attended with much difficulty. For this reason the discussion of specifications for wrought iron plate cannot be made as extended as that for steel plate. The specifications for plate metal used by a prominent engineer in the construction of a number of important wrought iron stand-pipes previous to his adoption of steel for this purpose, some years ago, were as follows:

The iron to have a minimum tensile strength of 50,000 lbs. per sq. in. sectional area, all to be of best charcoal hammered No. 1 iron, and each plate to be stamped C. H. No. 1, together with the name of the manufacturer. All plates to be inspected at the rolling mill, and tested under the supervision of the inspector appointed by the engineer.

A stand-pipe of some importance was built in 1893 from wrought iron, which was required to "be tough, fibrous and of uniform quality, and resist a tensile strain of 48,000 lbs. per sq. in."

In the construction of an important pipe line on the Pacific Coast, recently, the contractor was permitted to use either wrought iron or steel, the pipe being built from riveted plates. The steel plate specified was of the same quality as that used by the designing engineer in the construction of stand-pipes, and it may be inferred that the specifications for wrought iron plates for alternative use in the pipe line represent his standard of quality in the latter metal for stand-pipe construction. The requirements for wrought iron were as follows:

The wrought iron plates must be ductile, fibrous, of uniform thickness and free from blisters, seams, buckles, cinder spots, or rough or imperfect edges, and must admit of cold hammering or scarfing to a fine edge without cracking. It must be capable of being bent cold without fracture on a curve of diameter not over twice the thickness of the plate, 180° in the direction of the fiber, and 90° at right angles to the fiber.

Under test, the elongation in a length of 8 ins. must not be less than 15%; the reduction of area at the section of fracture, not less than 40%; the limit of elasticity, not less than 25,000 lbs. per sq. in.; and the ultimate tensile strength, not less than 50,000 lbs. per sq. in., which must be stamped on each sheet as a guarantee by the maker of the quality of the iron.

The thickness of these iron plates was about ¼ in. and the width was 60 ins. The steel specifications on the same work required "soft, open-hearth steel," to contain not more than 0.06% phosphorus or of sulphur, and not more than 0.60% manganese; the elastic limit to be 30,000 lbs. per sq. in.; ultimate tensile strength, 55,000 to 65,000 lbs. per sq. in.; elongation in 8 ins., on plates ⅝ in. thick and less, 22½% longitudinally, and 20% transversely; cold bend, flat.

*Compiled from Thurston's "Steam Boilers," pp. 96-7.

The degree of ductility required for wrought iron boiler plate in the "Rules of the United States Inspectors of Steam Vessels" (January, 1894), is as follows, the antiquated grooved "marine" section being retained, notwithstanding vigorous protests against it:

Iron of 45,000 lbs. per sq. in. tensile strength shall show a contraction of area of 15%, and each additional 1,000 lbs. tensile strength shall show 1% additional contraction of area up to and including 55,000 T. S.

The former quite prevalent plan of depending upon the time-earned reputation of the maker of wrought iron plate as a guarantee of quality may, perhaps, be more than ever advisable if the alleged deterioration has taken place. However, the engineer is rarely permitted to select the producer of structural metal, and since stand-pipe construction is no exception to this rule, it is the duty of the designer to impose upon the iron such tests as will insure the desired standard of safety in open competition.

Rivet Metal.—While it is the very general practice to use soft steel for power-driven rivets, most authorities concede that field rivets should be wrought iron. Since the two metals are known to be damaged about equally by working at a blue heat,* this preference for wrought iron, if consistent, must depend upon some other assumption than that wrought iron rivets may be finished at a lower temperature than steel rivets. As a matter of fact, wrought iron rivets may be heated to a considerably higher temperature without damage to the metal than is permissible with steel rivets, and this affords a defense for the preference which has, perhaps, resulted from practical test rather than from a consideration of critical temperatures. Upon this point of maximum permissible temperature a firm making a specialty of structural inspections states that:

Steel rivets should not be heated to over an orange color, much less than the heat put upon iron rivets, which are heated to nearly a lemon color, often without apparent injury.

A well-known authority in this class of work comments as follows on the same point:

Iron rivets are ordinarily heated up considerably hotter than steel rivets in using them. An iron rivet can be heated to what is called a "wash heat"—a temperature at which the intermingled slag in the metal begins to soak out from it—and this temperature can be safely attained without over-heating the wrought iron rivet. A similar temperature put upon a steel rivet would occasion the steel to be subject to such oxidation as would make it red-short.

A recent treatise** discusses the subject of field riveting as follows:

Field rivets are generally of wrought iron in all cases, as the difficulty of driving good steel rivets prohibits their use. The range of temperature at which steel can be effectively worked is very small, and, as in field riveting, considerable time is lost in passing the rivet from the forge to the riveters, a rivet has time to cool to a point below which it is not advisable to do any work upon it, as would be necessary in driving it.

One well-known engineer who uses steel rivets in stand-pipe construction specifies that "the heating forge shall be kept on the staging contiguous to the work." This designation of a precaution which is almost always observed on such work as a matter of convenience indicates that the engineer referred to had in mind the necessity of rapid work with steel rivets. It should be remarked, however, that he makes no other requirement for the rivet metal than that the "rivets shall be of steel, capable of an ultimate resistance to shearing of 45,000 lbs. per sq. in." The specifications for an important steel stand-pipe, built in 1894 upon the design of a prominent engineer, made the following provision for the rivet metal:

Steel for rivets shall have in test pieces ¾-in. in diameter, an ultimate tensile strength of from 48,000 to 56,000 lbs. per sq. in., and an elongation in 8 ins. of 26%. Heated uniformly to a light yellow, and cooled in water at 82° F., it shall bend around a circle of diameter equal to 1½ times the thickness of the specimen without fracture. Full-size rivet bars shall bend cold and double flat on themselves without sign of fracture on the convex side.

Accepting the standing of the engineers, above quoted, and the high quality of the work hitherto executed by them, as proof of the fact that steel

*"Mild Steel for Structural Purposes," Engineering News, Vol. XXVII., p. 43 (Jan. 9, 1892). Also, "The Working of Steel," Proceedings Institution of Civil Engineers, Vol. LXXXIV., pp. 114-214 (1886), reprinted in "Naval Professional Papers," No. 21.

**Johnson's "Modern Framed Structures," p. 257.

rivets may be used with success for stand-pipe construction, there is sufficient cause to believe that the general adoption of steel rivets for this purpose would not be wise, at least under the present almost, if not quite, universal practice of riveting by hand. Granting that the selection of wrought-iron is well sustained by the practical features involved, the necessity of discriminating between good and bad grades of that metal presents itself. It is asserted that "the manufacture of wrought iron rivets has become a specialty, so that the only reasonable assurance of securing the best grade is found by wording the specifications so that the contractor will use the desired make." Such is apparently the opinion held by a very considerable number of engineers engaged in this class of work, among the number being some of the most progressive known to the profession. On the other hand, it is urged that open competition should be allowed in the matter of rivets as in other classes of structural material as a matter of strict fairness to all concerned. A defense of the practice of making an exception of the rivets in this regard is found in the fact that for small jobs, such as the construction of most stand-pipes, the rivets are purchased by the keg in relatively small quantities, so that to incur the expense of a special rivet-rod test previous to the manufacture of the rivets would usually be looked upon as an extravagant proceeding. Indeed, the obstacles in the way of carrying into execution such a preliminary test are so great as to suggest that it would prove a dead-letter provision in a large majority of cases. A proper regard for the question of practicability demands a test of the rivet metal which may be performed during erection both readily and effectively. The following valuable opinion bearing upon such a practical test has been obtained from an authoritative source:

> With rivets, as purchased by the keg, for field riveting, in any large work, I would advise their being made from iron which had been specially tested and subjected to inspection; but where this is made impracticable, as in small jobs like stand-pipes, then more care should be taken with a test, which I believe to be the best in any event, as to the quality of the rivets—that is, that rivets put up as in actual practice, either machine or hand driven, shall be of such quality, and the work upon them shall be of such a nature that when any of these rivets are cut out from the work, with a cold-chisel or blows from a sledge, they shall cut out strong and shall not "fly," showing brittle material, under this treatment. This is a simple, practical test, which can be made anywhere.

The wording for a clause describing such a practical field test may be obtained by revision of the following excellent rivet-rod test, taken from a set of "general specifications":

> Rivet iron shall . . . be capable, without cracking or serious abrasion, of being heated to a good forging heat and made up either by machine or handwork into rivets, and of again being heated to a good red heat, forged as in riveting, allowed to cool, and upon being nicked and cut out of the work, it must show a good, tough, fibrous structure without any crystalline appearance. Rivet iron shall especially be required to flow well in riveting, and to be neutral in character and tough in fiber after being riveted.

A practical and easily-executed hammer test has recently been used by the U. S. Navy Department for steel rivets employed in boiler construction. Each ton of rivets from the same heat of steel was termed a "lot" for the purpose of testing. The hammer test was as follows:

> From each lot twelve rivets are to be taken at random and submitted to the following tests: Four rivets to be flattened out cold under the hammer to a thickness of one-half the diameter, without showing cracks or flaws. Four rivets to be flattened out hot under the hammer to a thickness of one-third the diameter without showing cracks or flaws—the heat to be the working heat when driven. Four rivets to be bent cold into the form of a hook with parallel sides, without showing cracks or flaws.

Although specifications sometimes fix the shearing strength that the rivet metal shall have, it is not often that such tests are actually made. In this connection the following statement by a prominent testing engineer is of much value:

> With rivet iron, the proportion of the shearing strength to the tensile strength is about 72%; and with rivet steel (having a tensile strength from 52,000 to 60,000 lbs. per sq. in.), the shearing strength is from 75 to 80%—ordinarily fully up to 80%—of the tensile strength.

Reviewing the entire matter of rivet metal, it may be concluded that under present conditions and methods of work the safest and most satisfactory results in stand-pipe construction are to be had by using the best available grade of soft charcoal iron rivets. Whether this end is to be accomplished by special reference to a certain make of iron rivets, as a standard of quality, or by severe physical tests, must depend upon the judgment of the individual engineer, but in any event he should get the best.

Workmanship.—As in other classes of structural specifications, it is wise to provide that "all workmanship shall be first-class in every particular," or the equivalent of that expression, in order to prevent the use of inferior methods in points of doubtful interpretation. It is also the practice of some engineers in stand-pipe construction to state specifically the right to reject any material in which flaws may be detected at any stage of the work at the expense of the contractor. The enforcement of such requirements, of course, demands that provision be made for adequate inspections, not only of the plates originally at the mills, but, in addition, both of the methods of workmanship and the behavior of the metal during the several stages of the shop work and erection. It has been by no means universal practice to provide such inspections of workmanship, even where there has been a proper regard for the quality of the material. Where such enforcement is to be neglected, it would seem that considerations of strict consistency and professional honor demand the omission from the specifications of these provisions, since they may afford but a false sense of security.

The fact that the damage sustained by the metal adjoining rivet holes in the process of punching increases with both the hardness of the metal and the thickness of the plate, has found recognition in the practice of various stand-pipe designers. It is the recommendation and practice of a number of authorities to require that in plates thicker than ¾ in. the rivet holes shall either be drilled, or, if punched, that the holes shall be reamed. It is stated* that, on the Pennsylvania Railroad, locomotive boiler plates are punched up to a thickness of ⅞ in. However, the standards both of material and workmanship in that case are of an exceptionally high character, so that it may not be taken as a precedent with entire consistency, unless equivalent safeguards are adopted in the execution of the work. Mr. F. H. Lewis, C. E.,** an advanced authority in the use of soft steel, after investigating the effect of thickness upon the extent of damage sustained in the process of punching, as indicated by the character of the fracture, recommends that ½ in. be the maximum thickness at which punching should be permitted without reaming, and in the same connection remarks that "in practical work the efficiency of reaming, being based on punching, must clearly share the deficiencies of punching. With good punching, the reaming no doubt accomplishes its object . . . . but it is quite certain to decrease in effectiveness . . . . with bad punching." It is asserted, and apparently with much reason, that not a little of the evidence offered in the controversy concerning the method of preparing the rivet holes is selected with no regard to the conditions governing the process of punching. In this connection an experienced maker and user of boiler plate, in stating the more serious abuses in the working of steel plate, includes "punching holes in an improper manner, that is, with improper punches and dies. This is not intended to mean that drilling is necessary in place of punching, but refers to the fact that a good plate may be badly damaged by the use of improper punches and dies." The stand-pipe specifications of most careful designers state, in detail, the required method of laying out the work in the shop and of preparing the holes, and it is common practice to designate the kind and condition of the punch. Although best boiler shop practice always punches the holes from the faying surfaces for obvious reasons, it should be remarked that this important matter was overlooked in the construction of a large stand-pipe which failed recently, although the specifications made the following provisions:

> Lay out all holes carefully and accurately, and punch with a center punch, sharp and in perfect order, from the surface to be in contact, and so that the bevel of the hole may be away from the surface in contact.

It is usual to specify that the edges of the plates shall be planed to a suitable bevel for calking, although some specifications allow them to be bevel-sheared and a few direct that the edges shall be chipped.

Steel plate suitable for stand-pipe construction will bend cold to the curve required, without damage. An expert on steel for marine boilers observes* that "if steel will not stand bending cold to the curvature required for the shells of cylindrical boilers, it should not be used, and those who do not possess rolls capable of bending plates while cold should get them." This remark was made in concluding a discussion of the causes which led to the failure of a steel plate during the construction of a boiler. The plate in question showed excellent qualities, both physically and chemically, and the only reasonable explanation of the failure was in the fact that the plate was heated to a dull red to assist in bending it, and in the judgment of the authority quoted, "there is no doubt that it was bent when it had cooled to a 'blue' heat, at which temperature it is imprudent to bend or work steel." An experienced maker and user of boiler plate, in commenting upon the more prevalent abuses in the working of steel plate, mentions first that of manipulating it at a "blue" heat, characterizing it as "the worst form of bad working," and places next that of "local heating and working, which is almost as bad as working at a 'blue' heat, unless the plate is afterward annealed in an efficient manner." In discussing the dangers of "blue-shortness," Howe** states that

> Not only are wrought iron and steel much more brittle at a "blue" heat than in the cold or at redness, but while they are probably not seriously affected by simple exposure to blueness, even if prolonged, yet if they be worked in this range of temperature, they remain extremely brittle after cooling, and may, indeed, be more brittle than while at blueness.

The practice of a very few engineers of requiring that all plates shall be bent cold with suitable rolls, while doubtless unnecessary with most stand-pipe builders, probably has a bearing in the case of numerous smaller concerns engaged in this class of construction. It would seem, however, that the opinions above quoted in relation to the dangers of "blue-shortness" apply with special force to the scarfing down necessitated in the present nearly universal practice of using lap-riveted joints in the construction of stand-pipes. An engineer who strongly advocates the use of wrought iron for stand-pipe construction has assigned the recent failure of a large steel stand-pipe to the simple fact that the metal was steel, and, in discussing the matter, remarks*** that he "cannot believe that steel is the material for stand-pipes when built with lap joints. The heating of one corner of a steel plate for the necessary scarfing and the local heating the joint must receive during erection, in order to draw it up tight, is certainly not very beneficial to any material like steel." As a matter of fact, however, this very timely criticism applies also to wrought iron, for Stromeyer**** has shown very conclusively that the two metals are affected to an equally serious extent by working at a "blue" temperature. Such being the case, the remedy for the dangers referred to is seen to be attainable only in a reform in the design of the riveted joints, a matter which does not properly fall within the scope of this discussion.

It should be observed in this connection that a recent advanced design by a pioneer engineer in this field called for proposals upon three kinds or combinations of joints. The relative bids on the superstructure, taking the average of six representative bids, were as follows: (1) All joints lap-riveted, 1.00; (2) horizontal joints, lap and vertical joints, butt-riveted, 1.08; and (3) all joints butt-riveted, 1.21.

Referring again to the matter of "blue" heat working, it is of interest that the clause in Cooper's "General Specifications for Bridges," relating to this important subject has been adopted in the specifications of a stand-pipe built in 1894. This clause is as follows:

> No work shall be put upon any steel at or near the

*Howe's "Metallurgy of Steel," p. 233.
**"Soft Steel in Bridges." Proceedings Engineers' Club of Philadelphia. Vol. IX., pp. 80-1 (Jan., 1892).—Eng. News, March 26, April 2, 1892.

*Traill in London "Engineering," Vol. XLII., p. 482 (Nov. 5, 1886).
**"Metallurgy of Steel," p. 234.
***Engineering News, Vol. XXXI., p. 113 (Feb. 8, 1894).
****"The Working of Steel." Proceedings Institution of Civil Engineers, Vol. LXXXIV., pp. 114-214 (1886).

"blue" temperature, or between that of boiling water and of ignition of hardwood sawdust.

It is stated* that at the works of Samson Fox, at Leeds, Eng., where the highest grade of flanging steel plate is executed on an extensive scale, the test for the minimum temperature at which flanging may be performed without damage to the metal consists in placing a hardwood hammer handle in contact with the plate; "if the wood does not blaze instantly on contact, the sheet is heated until it will; if it sparks only, it is not hot enough. The shape of a sheet is never allowed to be changed until this heat is shown."

In best practice it is required that the rivet holes shall match "true and fair" in assembling the plates during erection. One engineer requires that "hot rivets must enter holes without the use of a hammer." It is sometimes allowed that the drift pin may be used "sparingly," but it is the general practice among careful engineers to prohibit its use altogether. Some designers recognize the possibility of some eccentricity in the rivet holes, even in the best of shop work, and provide that such holes be reamed out as required. It is considered excellent practice to require that larger-sized rivets shall be used for such reamed holes.

Reference has already been made to the heat at which rivets may be forged without damage to the temperature beyond which the rivet suffers injury from overheating.

Some require that the rivet heads be finished with a suitable "snapping hammer." In any case, it is of much importance to insure by rigid inspection that sufficient stock is provided in the rivets to fill the holes perfectly, and also to allow the formation of a full and perfect head. It is customary with a number of engineers to prohibit the calking of rivets which develop leakage, and to require that such rivets be replaced with perfect ones.

It is usual to require that the calking be done with a "round-nosed" calking tool. Some engineers require inside calking, while a few specify both inside and outside. Others provide simply that the seams "shall be calked perfectly tight," and it is sometimes added "without the use of paint or putty." It has been stated by an authority in steam boiler construction that beyond a certain limit the amount of calking required to secure permanently tight seams may usually serve as an inverse measure of the quality of the workmanship as a whole. Such a measure should appeal to the engineer in charge through the character of his inspections, and to the builder through his business reputation.

Painting.—The methods of painting stand-pipes are subject to as much variation as in other exposed structural metal work. Some require that the inaccessible surfaces shall receive two coats of red lead, while others allow the omission of paint from the faying surfaces of the seams to permit the joints to rust. It is customary to require three coats of paint, at least one of which is put on at the shop. The details of the coloring pigments, of course, vary with the preference of the engineer. Too much stress cannot be placed upon the thorough scraping and cleansing of the plates before applying the first coat of paint.

Specifications for Stand-Pipe Metal and Workmanship.

The following specifications, embodying essential and consistent features of best current practice, are presented from a conviction that all stand-pipes should be constructed from a uniformly excellent grade of material and workmanship, and that reductions of cost, when necessary, should be accomplished through increased working stresses, and not by the sacrifice of quality. It is confidently believed that a general obedience to the dictates of this principle must lead promptly to an elevated standard of safety in stand-pipe construction. It is neither advisable nor practicable at this time to attempt the formulation of so-called "general" specifications covering all features of stand-pipe design. Various details, which do not bear directly upon the matters considered in this article, must be fixed in accordance with the local requirements. The more important of these items are: Agreement, site, foundation (including excavation, concrete, etc.), casing, anchorage, inlet pipe and valves, manhole, sizes and thicknesses of plates, kind and details of riveting, setting tank bottom, ladder or stairway, brackets, balcony, roof, and painting. The specifications given below relate solely to the structural metal and workmanship in the tank proper of the stand-pipe:

(1) Material.—The metal composing the stand-pipe shall be soft, open-hearth steel, containing not more than 0.06% phosphorus, and having an ultimate tensile strength of not less than 54,000 nor more than 62,000 lbs. per sq. in., an elastic limit not less than one-half the ultimate strength, an elongation of not less that 26% in 8 ins., and a reduction of area of not less than 50% at fracture, which shall be silky in character. Before or after being heated to a cherry red and quenched in water at 80° F., the steel shall admit of bending while cold, flat upon itself, without sign of fracture on the outside of the bent portion.

(2) Test Pieces.—All test samples shall be cut from finished material. Tensile test pieces to be at least 16 ins. long, and to have for a length of 8 ins. a uniform, planed-edged sectional area of at least ½ sq. in., the width in no case to be less than the thickness of the piece. Bending test pieces to be 12 ins. long, and to have a width of not less than four times the thickness, with edges filed smooth.

(3) Number of Tests.—For the purpose of identification, the number of the melt or heat of steel shall be stamped on each plate produced therefrom. At least one full series of tests, both chemical and physical, as above specified, shall be made of each melt, and such additional tests may be made as, in the judgment of the inspector, seem essential for corroborative purposes under varying conditions or methods of treatment of the metal.

(4) Finish of Material.—All plates must be free from laminations and surface defects, and shall be rolled truly to the specified thicknesses.

(5) Facilities for Testing.—Complete facilities for the tests and inspections shall be provided by the contractor, as required.

(6) Inspector.—Material will be inspected at the mill by (name of a trustworthy testing concern equipped to make both chemical and physical tests) or such other party as may be approved by the engineer.

(7) Additional Test Pieces.—If required by the engineer, the contractor will provide four certified samples of each thickness of plate used in the work, these samples to be 2 ins. wide and 16 ins. long.

(8) Workmanship.—All workmanship must be first-class in every particular.

(9) Working Steel.—The plates and angles must be shaped to the proper curvature by cold rolling. No heating and hammering shall be allowed for straightening or curving, or for other purposes.*

(10) Punching.—The work shall be carefully and accurately laid out in the shop, and the rivet holes punched with a center punch, sharp and in perfect order, from the surface to be in contact. The diameter of the punch shall not exceed that of the rivet by more than 1-16 in., and the diameter of the die shall in no case exceed that of the punch by more than 1-16 in. Rivet holes in plates having a thickness of ⅝ in. and over shall either be drilled or, if punched, shall be reamed not less than ¼ in. larger than the die sides of the holes, and sharp edges shall be trimmed.

(11) Beveling, etc.—All calking edges shall be planed to a proper bevel. All parts must be adjusted to a perfect fit, and properly marked before leaving the shop.

(12) Erection.—In assembling the work, the rivet holes shall match so that hot rivets may be inserted without the use of a hammer. Drifting is prohibited. Eccentric holes, if any, must be reamed and, if required, larger-sized rivets shall be used in such holes.

(13) Rivets and Riveting.—The best grade of soft charcoal iron rivets to be had in the market shall be used. Sufficient stock must be provided in the rivets to completely fill the holes and make a full head. The rivets shall be driven at such a heat as will admit of their being finished in good form with a button set before the rivet has cooled to a critical point. As often as may be deemed advisable for the purpose of testing the work, rivets shall be cut out at the direction of the inspector. The quality of the rivet metal and of the workmanship shall be such that the fracture of the rivets so removed at random shall show a good, tough fibrous structure without any crystalline appearance, and there shall be no evidence of brittleness. Loose rivets must be promptly replaced, no rivet-calking being permitted.

(14) Calking.—All seams must be calked thoroughly tight with a round-nosed calking tool by workmen of acceptable skill. Great care must be taken not to injure the under plate.

(15) Rejections.—Defective material and workmanship may be rejected at any stage of the work, and must be properly replaced by the contractor as directed.

(16) Final Tests.—After completion the work shall be tested by filling the stand-pipe with water, and the leaks, if any, shall be promptly and thoroughly calked. The stand-pipe must be water-tight before acceptance.

(17) Superintendence.—All inspections shall be made under the direction of the engineer who shall have general supervision of the work.

*If lap riveting is used, omit the expression "or for other purposes," and insert the following sentence: "No scarfing shall be done at a temperature below that of ignition of a hard-wood hammer handle, and no work shall be done upon the steel between such temperature and that of boiling water."

*"The Boiler Maker," Vol. II., No. 3, p. 8 (March, 1894).

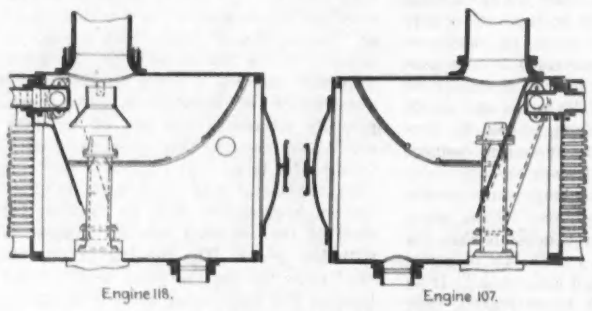

Fig. 1. Alabama Great Southern R. R.

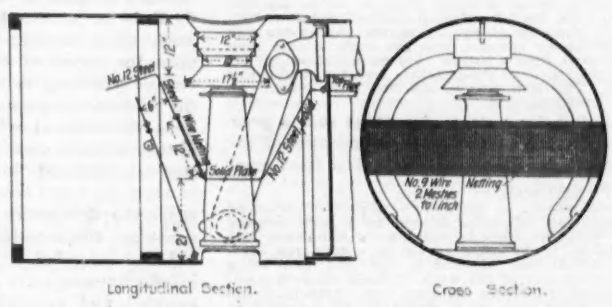

Fig. 2. Plant System Lines.

BEST FORM OF DRAFT SHEET FOR FUEL ECONOMY IN LOCOMOTIVES.

The draft sheet is an appliance fitted in the smokebox of a locomotive, for the purpose of regulating the draft through the flues and preventing a greater proportion of the draft passing through the lower tubes, and it has thus an important bearing on the fuel economy of the engine. A perforated draft sheet used on the South Carolina & Georgia Ry. was illustrated and described in our issue of Sept. 27, 1894, and we give below an abstract of a report presented by a committee at the meeting of the Southern & Southwestern Railway Club, at Atlanta, Ga., in November last, with illustrations showing some of the latest of the numerous arrangements adopted. The subject was also taken up at the January meeting of the club. We quote as follows from the report:

ARRANGEMENTS OF DRAFT SHEETS

The present form of single draft sheet as applied to boilers ranging from 56 ins. diameter and larger, and

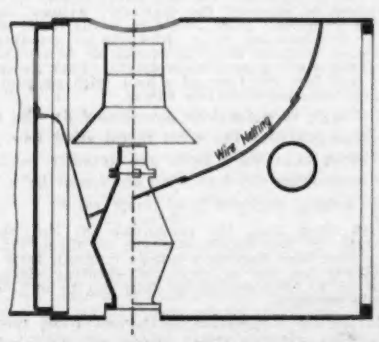

Fig. 3. Draft Sheet; Kansas City, Memphis & Birmingham R. R.

having from 250 to 275 flues, is defective in a marked degree. With a solid draft sheet, or baffle plate, extending from the top, or upper, flues downwards at an angle of about 75° to a distance of 12 to 15 ins. from the bottom of the smoke arch, with a movable plate

attached to regulate and control the draft through the flues, there will be one of several conditions existing:

1.—The movable plate is set so high, in order to get sufficient draft through the top flues, that the bottom flues are sacrificed; in other words, become stopped up in short time, on account of insufficient draft to keep them open; but the difference is made up by the advantage of increased area in heating surface in middle and upper flues, with the movable plate adjusted to height where the engine will steam best.

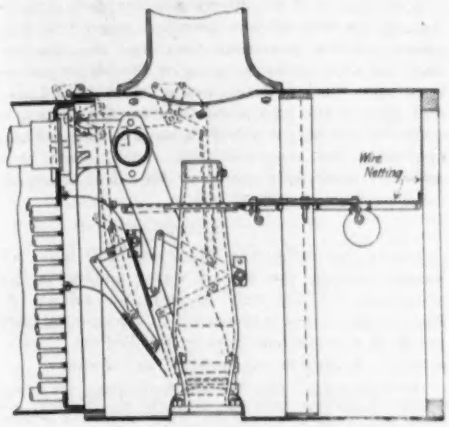

Fig. 4 Improved Draft Regulator.

2.—By the loss of bottom flue area, there is an increased draft on the remaining flues, which will cause severe pulling on the fire and unequal distribution of draft on grates, the draft being greater through the center and top flues and in the center and rear of grate surface.

3.—Whe the flues stopped up in the bottom of boiler there is a corresponding lowering of temperature, which, with the upper flues and flue sheet heated, produces unequal expansion and contraction, thereby causing trouble from flues leaking. The stopping-up of lower flues can be prevented by lowering the movable plate; but by so doing we are confronted with a condition equally as bad as when the flues were stopped up, namely, that the draft is reduced through the top and middle flues, and concentrated in a reduced number of bottom flues, thereby creating an excessive pull of fire in front of firebox, and burning an excessive amount of coal. All these conditions suggest very clearly the importance of a uniform draft through all the flues.

Your committee does not recommend a perforated sheet, for the reason that the openings are too nearly adjacent to the flues, and do not offer sufficient resistance to the gases, permitting too free access of same to the front end of stack, thereby causing excessive loss of heat.

We would call attention to the two forms of draft sheets used on the Alabama Great Southern R. R. (Fig. 1.) between Birmingham, Ala., and Meridian, Miss., in the same class of engines, being known as "Class E," cylinders 17 x 24 ins., 62-in. driving wheels, making the same runs. These engines run the distance of 153 miles with trains consisting of one mail car, one baggage car, two coaches and one sleeping car, with an extra sleeping car about four days each week, so that it might be called a six-car train. This train makes 47 stops. One great difference in the make of the two engines is in the size of the smokestack and nozzle, No. 107 having 3 and 3¼-in. nozzle and 17-in. stack, and No. 118 having 4¼-in. nozzle and 15-in. stack. In August No. 107 made 31.7 miles to the ton of coal, and No. 118 made 40.5 miles, a considerable saving in favor of the smaller stack, short exhaust pipe and large nozzle. A freight engine on the same line has been changed to correspond with the device in No. 118, and shows 2.7 miles per ton of coal over one equipped with draft sheet similar to that on No. 107.

Mr. Wm. Rutherford, Superintendent of Motive Power of the Plant system lines, is using the draft sheet and part end arrangement shown in Fig. 2 on an engine running between Savannah, Ga., and Jacksonville, Fla., on a passenger train of seven cars. An engine with 17-in. cylinders makes the round trip of 344 miles on six tons of coal, an average of about 57 miles per ton. The engine has a 4⅝-in. nozzle. Mr. Briggs, Master Mechanic of the Kansas City, Memphis & Birmingham R. R., is using the arrangement shown in Fig. 3, on an engine with cylinders 19 x 26 ins., with a nozzle 5¼ ins. diameter. Your committee would judge that good results should be obtained in regard to economy of fuel with an engine with that size exhaust opening.

The stacks, nozzle and front end undoubtedly have a close and mutual relation with the draft sheet, and different conditions of service necessarily for the draft in the fire, and if this can be regulated at will, a saving of fuel is bound to follow. In this connection, your committee submits a plan (Fig. 4) and explanation of a double draft sheet, 13 of which are in successful operation, showing a saving of from 20 to 25% in fuel, not taking into consideration the labor saved by the cleaning of flues. The nozzles have also in every instance been enlarged from ¼ to ⅝ in., thereby adding, in connection with the saving of fuel, increased power to the engine, as shown in the table given below.

Four ten-wheel engines, two simple and two compound, were run on a division 131 miles long, and over grades nominally 69 ft. maximum, some of them as much as 77 ft., with about 45% of the line curved from 3 to 8°. The eight-wheel engines were run on a division 111 miles long, where the grades are lower, being about 60 ft. maximum, and with less curvature. All of these engines haul vestibule trains of eight cars, and sometimes nine, making on the West Division from eight to ten stops, and on the East Division from five to seven stops. The records were taken from these engines that were equipped with the single diaphragms with a movable draft plate, for a period of four months, when they were removed, and the double draft sheets with movable draft plate were substituted, and records taken with this device for four months, as follows:

Effect of Draft Sheets and Nozzles on Coal Consumption.

Engine.	Cylinders.	With single draft sheet. Coal consumed per mile.	Size of nozzle.	With double draft sheet. Coal consumed per mile.	Size of nozzle.	Saving with double draft sheet, p. c.
	ins.	lbs.	ins.	lbs.	ins.	
Eight-wheel	18 × 24	67	4⅝	67	5	....
" "	18 × 24	57	4⅝	50	5	12
" "	18 × 24	65	4⅝	55	5	15
Ten-wheel	19 × 24	42	5 3-16	42	5⅜	....
" "	19 × 24	67	4⅞	44	5⅛	34
" " (Comp.)	19 × 28	47	5	44	5⅜	6.4
" " "	19 × 28	56	4⅞	45	5⅜	19.9

Engines not showing a saving with the double draft

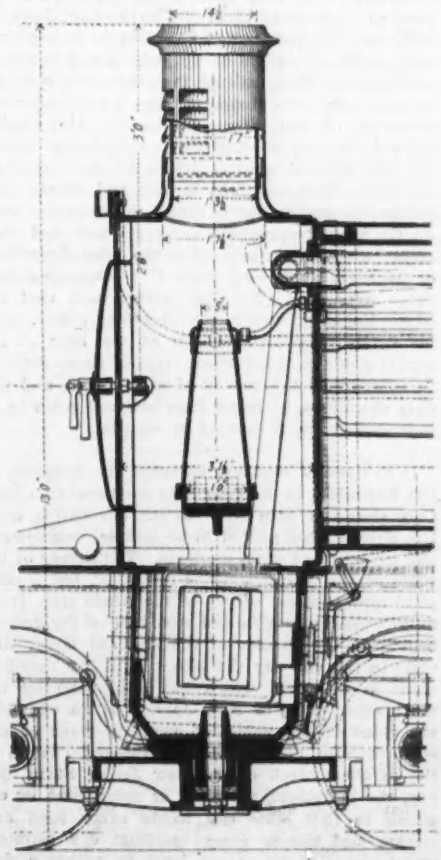

Fig. 5. Smokestack with Draft Openings; Highland Railway, Scotland.

sheet had been changed to other runs on different divisions, and harder service, but burnt approximately the same amount of coal as when using the single draft sheet, but with much increase in diameter of nozzle, which has proved a great advantage in free working of the engine.

A series of experiments should be made with the pyrometer; this can be easily done by an extension long enough to pass down through the extension front back of the stack as close to the T head as possible, and about 6 ins. forward of the flue sheet, and readings can be taken which would indicate accurately, by starting at the bottom row of flues and recording each movement in a vertical position upwards to top row of flues by one or two inch movements. An increase or decrease from the lower or higher readings would indicate improper adjustment.

The double draft sheet shown in Fig. 4 is regulated from the cab, so that the draft openings can be opened or closed, according to the service being performed by the engine.

As a matter of interest in this connection, we may note a rather curious smokestack adopted by the Highland Railway, of Scotland, whose line traverses a country subject to severely cold and strong winds during the winter. As shown in Fig. 5, the smokestack is double, the inner shell being 15½ ins. diameter inside at the throat, and 16½ ins. at the top, while the outer shell is 19 ins. diameter inside. This outer shell has four rows of louvre openings, which cause an upward current between the shells, and thus increase the draft and assist the steam in escaping from the top of the stack when running against a heavy wind. In this connection reference may be made to draft regulators in the front of the smokebox (as tried at one time on the Manhattan Elevated Railway), or at the base of the smokestack (as in the Luttgens device and on some engines in Sweden), and to the shield which French engineers frequently place in front of the top of the stack, so as to give the steam a free escape.

TESTS OF STEEL FOR BRIDGES.

It has frequently been claimed by structural steel makers that in drawing specifications the elastic limit should not be specified to exceed half the ultimate strength, and that at least 10,000 lbs. variation should be allowed between maximum and minimum limits of ultimate strength. Some recent tests, however, have shown that there is no difficulty in procuring steel with an elastic limit equal to two-thirds the ultimate strength, and that a difference of 7,000 lbs. between the specification limits for ultimate strength can be met without difficulty. We are indebted to Mr. George H. Thomson, M. Am. Soc. C. E., Consulting Engineer, for the accompanying condensed record of 71 tests upon 600 tons of bridge steel made to his specifications and rolled in January, 1895, by the Pennsylvania Steel Co. and Carbon Steel Co., and inpected by Mr. A. C. Cunningham, of the American Engineering and Inspection Association, of Albany, N. Y. The steel consisted of plates and angles ⅝-in. to ¾-in. thick, for use in six spans on the Central Vermont R. R., and no difficulty was found in meeting the high requirements of the specifications, only a very few pieces tested falling below the requirements. The lowest elastic limit found was 61.1% of the ultimate strength. The condensed record of the tests is as follows:

Tests of Bridge Steel.

	Average.	Lowest.	Highest.	Range.	Specif. limit.
Areas, sq. ins.	0.767	0.581	1.415	0.834	Spec. limit.
Carbon, %	0.138	0.115	0.190	0.075	No limit.
Phos., %	0.070	0.052	0.089	0.028	0.08
Mang., %	0.340	0.023	0.480	0.457	0.45
Sul., %	0.440	0.015	0.390	0.375	0.04
Copper, %	0.041	0.001	0.160	0.159	0.20
Elas. limit, lbs.	40,561	37,120	43,480	6,360	Not less 38,000.
Ult. strength, lbs.	60,607	57,100	63,530	6,430	58,000 to 65,000.
Elong. in 8 ins., %.	28.10	25.00	31.80	6.800	24% to 26%
Reduction, %	55.70	44.00	62.40	18.40	50%

Average elastic limit 40,561 lbs. / Average ultimate strength 60,607 lbs. = 66.81%

Steel from Carbon Steel Co.:

Highest elastic limit 43,480 lbs. / Ultimate strength, same piece, 57,160 lbs. = 76.07%

Steel from Penna. Steel Co.:

Lowest elastic limit, 37,120 lbs. / Ultimate strength, same piece, 58,900 lbs. = 63.02%

Elastic limit of piece with 40,650 lbs. / Highest ultimate strength 63,530 lbs. = 63.90%

Elastic limit of piece with 39,090 lbs. / Lowest ultimate strength, 57,100 lbs. = 68.35%

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The article by Professor Pence, on "Stand-Pipe Specifications," which appears in this issue, represents a large amount of painstaking investigation. Many important points are discussed, some of which might properly bring out the experience and opinions of engineers engaged in this class of construction. We shall be pleased to give space to communications which will add to the common store of practical information on this subject. Professor Pence's article will be added to his series on "Stand-Pipe Accidents and Failures," which appeared in this Journal during the first half of 1894, and the whole will be published in book form at an early date. Since the articles were completed a number of accidents, not included in the record, have come to light and a few additional accidents have occurred, thus making necessary an extension of the record. If any of our readers know of failures or accidents to water-works tanks or standpipes, which were not mentioned in the series of articles concluded in June, 1894, or in the additional list given below, we shall be pleased to have them promptly inform either the editors of this journal or Prof. Wm. D. Pence, of Champaign, Ill. The additional accidents or failures are as follows:

Holbrook, Mass.	Chicago, Ill.
Bayshore, N. Y.	Hampton, Ia.
Billingsport, N. J.	Anthony, Kan.
Erie, Pa.	Dodge City, Kan.
Wilmington, N. C.	Holdredge, Neb.
Pelican Sawmill, La.	Salem, S. Dak.

The "Commercial Bulletin," of Boston, Mass., editorially says that "the Engineering News first solved the problem of rapid transit in Boston by the suggestion of a subway," and it is particularly gratifying to this journal to see its suggestion adopted, after much opposition and stormy debate, and now about to become an accomplished structural fact. In the adoption of this subway plan for the relief of narrow and congested streets in the heart of a great city, Boston leads the other cities of the United States in the solution of a most troublesome municipal and engineering problem. This subway will be protected from the storms and obstructions of winter and the heat of the summer; it provides rapid transit on lines distinct from those of ordinary traffic, and thus most effectually much more than doubles the capacity of the streets effected, without interfering with existing structures. It has so many advantages over the other plans suggested that a number of its former most bitter opponents are now its enthusiastic advocates.

It is a source of regret, and should be one of shame, to the great and wealthy state of New York that a complete and accurate topographic survey of its territory is not yet in existence. Whether the task of making such a map, already well begun, shall be continued will probably be decided by the legislature within a few days. At the present time the State Engineer has introduced in the legislature a bill providing for a topographic survey, to be made in co-operation with the U. S. Geological Survey, and for the continuance of this survey until the work is completed. But the re-establishment of the old bureau of Adirondack Land Surveys is also provided for in another bill, now before the Ways and Means Committee of the Assembly, and this second bill, which is said to have considerable support, proposes a distinct and isolated field of work and antagonizes the first bill. By reason of the strong influence which is being exerted in favor of this bill, and the general lack of appreciation by the legislators of the real importance of a complete survey of the state, it is said to be likely that either both bills will fail, or that the one of least merit will be passed. The Adirondack Survey, as a separate work, was strongly condemned by Governor Cleveland, in 1883, when he vetoed a bill for its continuation which was hurried through in the last days of an expiring session of the Assembly. The reasons Mr. Cleveland then gave against the bill are as true now as they were then. This bureau, between 1872 and 1884, expended $135,000 in surveying a very small percentage of the Adirondack territory; and the Governor insisted that this survey should be placed in more competent hands and under the direction of the State Engineer. He further pointed out that to establish an independent bureau for this especial survey, outside of the control of the State Engineer, was unwise and extravagant legislation, and tended to retard the excellent work on the state topographic survey, which had been going on so successfully under the joint supervision of the State Engineer and the U. S. Geological Survey. Governor Cleveland further said that the State Engineer was a constitutional officer, with his duties prescribed by law at the time of the adoption of the constitution. One of these duties is to superintend the survey of state lands, and this duty should not be taken from him and given to an independent officer created by statute.

If motives of economy influence the members of the Assembly, in deciding between these two bills, they should at once drop the one advocating what has already been proved to be unwise, unnecessary and extravagant in its methods. The survey of the wilds of the Adirondacks is desirable; but a complete topographical survey of the whole state is infinitely more desirable and would be of far greater benefit to the citizens of the state at large, who must in the end pay the bills. With the excellent work in this field which has been done by the neighboring state of New Jersey, as an example, the value to the public of complete maps of the state of New York should be evident. Thanks to the excellent work of the New Jersey State Survey, the individual, promoter of enterprises, or engineer in that state can locate every road and stream and almost every building; can estimate every elevation above sea level to within a few feet; and can very closely define every watershed in the state, utilized or unutilized. The geological characteristics of each section of the state are also clearly shown; and, in fact, about all the information a map can convey is placed at the service of the seeker after this information. The state of New York has made a fair beginning in this important work on the same plan of co-operation that has resulted so successfully and satisfactorily in New Jersey. But the results are as yet confined to isolated patches of territory, and are of comparatively little value until the whole territory is covered and a complete topographic map, or series of maps, is made and published. To delay the prosecution of this important work by wasting money upon an isolated and comparatively unnecessary survey of the Adirondacks would be a most serious neglect of the interests of the state at large. Among our own readers there are many who fully appreciate the numerous uses and the practical value of a complete mapping of the state; and we trust that they will use every effort to influence and instruct the men responsible for the passage or defeat of the bills referred to, so that they too may appreciate the responsibilities resting upon them and may more fully recognize the effect of any ill-considered or prejudiced action.

Among the arguments which one still hears advanced against the use of water meters is that some one will "get rich" if they are adopted. An illustration of this is presented in the opening paragraph of a recent editorial in the Buffalo "News," entitled "A Million for Meters," as follows:

> There is danger that the effort to make the water supply of Buffalo securely adequate at all times and under all conditions will be diverted into a scheme which will make somebody rich by the sale of water meters.

Following this note of alarm is what the "News" calls a "fair sample of the communications" it has received on the subject of the full meter system for Buffalo. The writer of this particular letter tries to make the question a sanitary one, urging, among other things, that:

> The poor man will not pay for water to wash himself and his family when he can hardly get money to pay for food, but if the water he uses costs nothing extra, whether he uses much or little, he will use plenty of it and the result will be beneficial to the community.

Probably neither the writer of the letter nor the editor who takes it as conclusive evidence ever paused to consider that, at the moderate rate of 10 cts. per 1,000 gallons (the city only charged 3 cts. per 1,000 gallons to manufacturers in 1890), a man could indulge in anywhere from one dozen to four dozen baths for a nickel. It may also be remembered that the man whose income is so small that it is barely sufficient for food does not live in a house that boasts such a luxury as a bathtub, anyway. As stated above, however, facts of this sort have not yet been impressed on the editor, apparently, and he winds up his article as follows:

> If a million dollars is to be spent for water in this city, let it be spent for water—and not for apparatus to restrict the use of water.

Some objection might be made to this "comparative estimate" of cost, as being based on rather a slight basis of fact; but, accepting if for the sake of argument, it may be pointed out that, if contractors are to "get rich" from the work, as the "News" fears, it really makes no difference to the city whether a contractor for pumping engines or a contractor for water-meters is the lucky man.

Of course, the interest charges on a million for a tunnel and pumping plant are the same as on a million for meters, allowing the "News'" estimate to be correct; but it must not be forgotton that the coal, engineers, fireman and other essentials for pumping an extra amount of water will mean the annual expenditure of a very large sum, in addition, and that not only will it be necessary to provide larger tunnel and pumping capacity, but larger street mains will be needed to distribute the water.

As was pointed out in these columns in our issue for Jan. 31, it is the waste and not the use of water which meters are designed to prevent. And the waste in question may cause direct financial loss to the wage-earners of a city, as was the case in Buffalo itself recently, when the Wagner Car Works had to lay off 50 men for lack of water, which lack was attributed by the water-works officials to the vast quantities then being wasted through wide open faucets to prevent the freezing of house pipes. With meters in use, householders would soon learn that a very small stream is just as effective for the above purpose as a large one, and that protection of plumbing against freezing

might be even cheaper than the waste of water for the same end.

The death of Mr. Charles W. Copeland, of Brooklyn, noted in our issue of Feb. 14, recalls the fact that this veteran engineer was one of the founders of what may be called the first engineering association in this country. In Engineering News of Sept. 10, 1887, appeared a contribution, unsigned, but written by an engineer contemporary with Mr. Copeland, and whose name is well known to the profession in the United States—Col. Julius W. Adams. In this letter Col. Adams described the proceedings of a private club of engineers in Brooklyn which flourished over 44 years ago, and was the first engineering association, strictly speaking, in the United States. This club exercised a material influence in founding the American Society of Civil Engineers, in 1852, and in reorganizing that society in 1865. The Brooklyn club was called the "Wa-ca-ma-ha-ga," a combination of the initial letters of the original members' names. These members were Henry R. Worthington, Charles W. Copeland, James O. Morse, James How, C. M. Guild and Julius W. Adams. The initial letter of the last name supplied the vowel necessary to round out the name of the club. To this original membership were added later the names of A. W. Craven, G. V. Fox, Gen. George S. Greene, James P. Kirkwood, William E. Worthen, James K. Ford and Richard S. Smith. Of these 14 men, 5 have been Presidents of the American Society of Civil Engineers; most of them have been members of that Society, and all of them are well known to American engineers. To Mr. Morse, who was for a long time the Secretary of the American Society of Civil Engineers, practically belongs the credit of holding it together during the Civil War and of later enabling it to date its continuous existence from its founding in 1852. Mr. Copeland, whose recent death recalls this pioneer engineering organization in the United States, was a marine and mechanical engineer, and with the late Henry R. Worthington, was one of the founders of the American Society of Mechanical Engineers, and for a time was a Member of the American Society of Civil Engineers.

It is interesting in this connection to further note that Appleton's "Mechanic's Magazine and Engineer's Journal" of 1851-52 contains a number of contributions from the members of this early club, and was edited by another member, Col. Julius W. Adams. The first article in this magazine for Jan. 1, 1852, is a description of the engines of the steamships "Pioneer" and "City of Pittsburg," built at the West Point foundry, of which Mr. Copeland was then the constructing and designing engineer, and embodying many of his suggestions, though the general designer was Mr. Frederick Rumph. The "Pioneer," of this Philadelphia and Liverpool line of steam-packets, is noted as having started out from Philadelphia, on Nov. 6, 1851, and as having made the passage to Liverpool in "the remarkably short time" of 18 days, burning anthracite coal and "only using sails for 30 hours."

THE GRANTING OF FRANCHISES BY TOWNS AND CITIES.

A timely measure, relating to the granting of public franchises by municipalities, has been recently introduced into the Wisconsin legislature. The object of the proposed bill is to prevent the giving away of franchises by cities, towns and villages, under the influence of popular feeling, or through mistaken ideas as to the extent and intent of the action taken, or because of the endeavors of parties who are working to further their private interests. The proposed bill is likely to attract considerable interest in a direction too long neglected; and it is, at least, a precautionary measure of some merit, though it contains features that may be objected to.

Under the provisions of this bill, no grant can be made by a municipal corporation of a franchise to establish, maintain, or operate a street railway system, gas or electric plant, water-works, telephone or telegraph system, etc., except under certain conditions named in the bill. These conditions, briefly stated, are that no franchise shall be given for a longer term than 21 years, and none shall be exclusive; and the right must be reserved to purchase the plant, on the termination of the franchise, at a price equal to the value of the physical plant, as determined by mutual agreement, or by a board of arbitration selected by both parties, or by the Circuit Judge, in case of failure by the preceding methods.

In case purchase by the municipality is not deemed desirable, an extension of the franchise may be granted to the highest bidder for a term of five years, after which the town shall again have the right of purchase; or, an extension may be again granted for another five-year term, and so on for an indefinite time. In case the franchise for any five years is granted to another than the operator of the prior grant, the plant must be purchased at its physical value by the new operator, this value to be determined practically as before stated, the owner in this case, however, taking the place of the town.

Prior to the granting of any franchise the city or town authorities must prepare full specifications containing the rules and regulations under which the franchise is to be operated, including the maximum rate of charge and providing for monthly statements to the city of gross receipts, business, etc. Proposals for any franchise must be advertised for at least three weeks, in three prominent newspapers of the immediate vicinity; and any and all bids may be rejected, but only the highest can be accepted, as based upon the highest percentage offered upon gross receipts. The acceptance of such a bid requires two-thirds the total votes in the governing body of the city or town; and the grant itself must contain all the rules and regulations, terms and conditions upon which the franchise is granted. All franchises in force at the time of the passage of the law may not be renewed, except in accordance with its provisions.

While many of the features of this bill are commendable and would tend to check the hasty, ill-considered or improper action too often characterizing the granting of franchises, it contains, at least, one condition which seems to demand modification. That is the provision forbidding the granting of exclusive franchises. So long as the municipality fully controls the framing of the conditions under which the business covered by the franchise is to be carried on, and is empowered to enforce these conditions by penalties extending to the withdrawal of the grant in case of permanent non-compliance, there seems to be no good reason for refusing to grant an exclusive franchise for a term of years; and there are some very good reasons why to grant such exclusive rights would be good public policy.

In nearly all cases the party receiving such a franchise must invest a very considerable amount of money. If the bidder for such a franchise knows that his lines of rails, wires or pipes may be at any time paralleled by a competing corporation the investment is attended with a risk which greatly decreases its attractiveness, and in even greater ratio the price which a contractor will bid for it is decreased.

To give a concrete example: Suppose a city calls for bids for the establishment of an electric light plant, to furnish both street and private lighting on terms which can be computed to promise a return of 20% on the capital invested. If the city makes this franchise an exclusive one there will be plenty of parties ready to offer the city a handsome percentage of the gross receipts, amounting to the bulk of the surplus profits over what is necessary to pay interest at 5 or 6 per cent. on the capital actually invested. On the other hand, if the franchise offered is not an exclusive one—if the company is likely to have its investment placed in jeopardy just when it begins to be most profitable by the granting of a franchise to a rival company—then it can by no means afford to pay any considerable percentage of its receipts to the city. Stated in fewest words: If the city proposes to sell a franchise, it should endeavor to make it so valuable as to attract a number of responsible purchasers, who will be able and willing to bid a handsome price for it.

But, from another point of view, it is bad policy for a city to attempt to secure good service by granting franchises to rival companies, or even to leave a door open for the granting of a franchise to parallel the lines of an established company. Enterprises of this class, water-works, gas works, electric light and power plants, street railways, etc., require for their proper development the investment of capital somewhat ahead of actual traffic requirements. If the existing company knows that its property is safe, it will readily make outlays for such developments, as it will be actually for its interest to do so. On the other hand, if to work up a large and profitable traffic is to invite outside competitors to come in and reap part of the profits, the tendency will be to delay outlay for improvements in service and extensions to outlying districts as long as possible, regardless of public inconvenience which may be caused thereby.

But it is often argued that competition between rival corporations is a greater lever in securing better service and lower rates than any franchise requirements can possibly be. Suppose, for argument's sake, that this is true, it is next in order to prove that such competition can be permanently maintained. There are plenty of cases where rival gas companies have sold gas at the cost of manufacture, rival water companies have sold water below the cost of pumping, and rival street car companies have carried passengers at rates which barely paid their weekly wage account; but there is never a case on record where such a condition of affairs has proved permanent. Evidently it could not continue, for no industry can long be maintained unless its returns are sufficient to pay its expenses. In every case where such competition has been secured, its continuance has been brief. In the end one corporation forces the other into bankruptcy and then absorbs it; or else some combination or consolidation is effected. This combination is usually the opportunity for increasing the capitalization to a point which will, at least, represent the cost of the combined plants; and so, henceforth, the rates charged the public for service are made sufficient to pay the interest on the duplicate and needless plant.

Nor does this tell all the story of the waste due to such mistaken policy. Engineers know well the injury done to city street paving by the laying of water mains, gas pipes or electrical conduits. What shall we say then of the folly of permitting this injury to be repeated twice over, in the pursuit of the will-o'-the-wisp of "free competition"?

The proper course, then, for a city to pursue in disposing of a franchise is to make it a monopoly during the term which the franchise runs, and to state in a plain contract with the company receiving the franchise just what service must be rendered and what rates may be charged.

The careless or corrupt granting of privileges to corporations by cities and towns is altogether too common, and this practice should be guarded against by all reasonable and possible legislative action. But, in taking such action, it should be also remembered that the gains of corporations are supposed to be offset by actual services performed, and without reasonable gain there can be no satisfactory service. No corporation proposes such service out of charity, and in estimating the future business upon which the price to be paid for the privilege is based, the corporation is entitled to a reasonable guarantee from interference in its plans, the development of which must be largely a matter of time.

The municipality, on its part, is fully entitled to protection against undue charges and inefficient service, and it should see that it has this protection in the conditions originally imposed, and that these conditions are rigidly enforced. But, so long as the corporation honestly fulfills all the conditions of its contract, even though it should reap a larger profit than it anticipated, thus attracting offers of outside competition, it appears to be neither equitable nor wise for the city to permit a division of gains by granting a franchise to a competitor. The city really gains nothing permanently by so doing, and, as before mentioned, it stands a strong chance of losing, in interruption to traffic, in less efficient service, resulting from reduced means of performing service, and in a final return to previous conditions, with the winning party handicapped by money lost, or by a top-heavy capital upon which to base its charges.

LETTERS TO THE EDITOR.

AERATION AS A MEANS OF PURIFYING SEWAGE AND WATER.

I note that in my letter under the above title in your issue of Feb. 21 in the clause, "when artificial aeration is used for renewal of air in the filter," removal is printed in place of renewal. It is an unfortunate misprint, as it rather spoils the point of the whole note. Very truly yours,

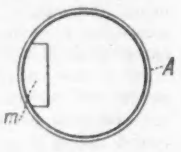
Geo. W. Fuller.

Lawrence, Mass., Feb. 23, 1895.

(We regret the typographical error, which, doubtless, would have been discovered had not removal in this case conveyed somewhat the same idea as renewal; that is, aeration is used to remove the air after its usefulness is passed, thus giving place, of course, to the fresh air supplied by aeration.—Ed.)

DEVICE FOR INSPECTING THE INTERIOR OF PIPE SEWERS.

Sir: In your issue of Sept. 24, 1894, (p. 249), I described a device for inspecting the interior of pipe sewers. More recent use has suggested a modification, permitting the mirror B in that figure to be omitted, except in special cases. Let A in the accompanying figure represent the mirror A shown in the former illustration. A small auxiliary mirror (m) is cemented upon the face of mirror A at a slight angle therewith. The sewer is then illuminated by mirror A, and the image is viewed in mirror m without the observer's head cutting off the source of light, as the image is thrown slightly to one side. This arrangement permits a more rapid use of the apparatus, and the independent mirror B (p. 249) is only used when the observer wants to see an object from a particular point of sight.



Yours truly, Walter C. Parmley,
First Assistant City Engineer.

Peoria, Ill., Feb. 5, 1895.

CORROSION OF THE VICTORIA BRIDGE.

Sir: My attention has been drawn to a paragraph in your issue of Jan. 31, in which you give an extract from Mr. Wood's paper on "The Protection of Iron and Steel from Corrosion," and in which he refers to the Victoria Bridge, across the River St. Lawrence, at Montreal, as being so seriously corroded that the whole floor beam structure requires renewal, and then he goes on to predict that the structure will decay from corrosion within a century from its construction.

Whatever may happen to this structure between this and the year 1959 it is impossible to say, but let me assure Mr. Wood that as yet there is nothing unusual in the corrosion of the Victoria Bridge beyond what can be traced to certain causes, and that no more difficulty is experienced at this time in maintaining the bridge and warding off corrosion from natural effects, than has been experienced in the past; but, on the contrary, the bridge having now been ventilated, less corrosion takes place than for many years after its construction. There is, however, an element of corrosion from the passing of refrigerator cars, which has contributed a new feature in the maintenance of this structure, and which has also been experienced in other cases, where the drippings from the cars have, in course of time, had deleterious effects.

The main cause of the renewal of the floor beams has been brought about by the increased loads of locomotives and the large additional weight imposed by the driving wheels upon the floor beams, and we have thought it advisable to commence and proceed gradually with a new system of flooring, strengthened to meet the increased loads as between the year 1859 and the present time, but we have no more anxiety in regard to corrosion from natural causes than we have had in the past; in fact, as I have stated, owing to the ventilation of the bridge, the structure is in a better condition to-day as regards corrosion from natural causes than at any time since its construction, and whatever may be the effect of time by corrosion on other structures, I see no reason to anticipate premature decay in the Victoria Bridge owing to any such results. Yours truly,

E. P. Hannaford,
Chief Engineer Grand Trunk Ry. Co.

Montreal, Feb. 12, 1895.

SHIP-CANAL PROJECTS AT SEATTLE, WASH.

Sir: In your issue of Jan. 24 there appeared an article headed "The Seattle-Lake Washington Canal," in which two projects were sadly mixed. Believing them to be of more importance than the "torpedo" accident referred to in your subsequent issue, I take pleasure in giving you the main facts concerning both of the proposed North and South canals.

The last Congress appropriated $25,000 for a canal to connect Lakes Union and Washington with Puget Sound via Salmon Bay, having previously received a favorable report from a board of engineering officers, consisting of Col. Mendall, Major Handbury and Capt. Symons.

This project contemplates the construction of a canal 26 ft. deep, 80 ft. wide on the bottom, with slopes 1½ to 1 from Union Bay on Lake Washington, through a narrow ridge 50 ft. higher than the level of Lake Washington, to Lake Union, a distance of about 1,800 ft.; also a canal of the same dimensions from Lake Union to the head of Salmon Bay, some 6,700 ft. through a broad valley but a few feet higher at its upper end than Lake Union. The water of Salmon Bay is to be raised to and maintained at a level with Lake Union and a lock 50 × 400 ft. in the clear is to be placed at the mouth of Salmon Bay. Through the shoal water at the mouth of Salmon Bay the channel width is to be 300 ft. on the bottom. Through Salmon Bay, the shoals at the head of Lake Union and Union Bay, the channel is to have a bottom width of 200 ft.

The observed extreme rise of the tide in Seattle Harbor is 17.7 ft.; the mean tide is 13.6 ft. The mean level of Lake Union is 25.5 ft. above extreme low tide, and that of Lake Washington is 32.4 ft. above the same datum.

From this it is seen that Salmon Bay will be raised about 7¾ ft. above extreme high tide, a change that will submerge nearly 200 acres of land, besides flooding a number of large mills in the town of Ballard. Congress, doubtless fearing that exorbitant prices might be asked for damage to property thus submerged, stipulated that no part of the appropriation could be expended until the entire right of way and release from all damages had been secured to the Government. Delay in satisfying these demands has to some extent been occasioned by the fact that the route as laid down by the board of engineers was simply a paper location, the Treasury ruling that no funds were available for the purpose of defining the exact ground needed.

The Seattle Chamber of Commerce, through its various committees, has estimated that the entire cost of the right of way and release from all damages to abutting property can be secured for something less than $150,000, which amount includes large concessions from the different milling interests and large property holders.

Legislation has recently been secured from the State allowing the County Commissioners to levy a tax, not to exceed one mill per annum, for the purpose of acquiring by condemnation such lands and releases as the Government may require.

The estimated cost of the canal, exclusive of the conditions imposed by Congress, is in round numbers $2,000,000.

The other project, called the South Canal by way of distinction, is being pushed by private capital. It leaves Puget Sound in Seattle Harbor at the south end of the city (along the line occupied by words "City Boundary" on the map in your issue of Jan. 24) and passes directly east to Lake Washington.

This enterprise was first projected to reclaim the tide flats (over 2,000 acres) in that vicinity.

The State, the present owner of the flats, has entered into a contract with the Seattle Waterway Co. by which the latter agrees to fill these tide lands for 16 cts. per cu. yd., including the building of retired bulkheads along the system of waterways recently established, which amount, plus 15% for profit, becomes a first lien on the property so reclaimed, drawing 8% interest when sold.

The material from the canal prism and from the waterways will furnish the filling for the tide lands. The waterways are to be dredged 500 ft. wide on the bottom; the canal waterway leading from the main waterway to the canal 150 ft. wide on the bottom, and the canal proper to be 80 ft. wide on the bottom, 10,250 ft. long and 26 ft. deep. A lock 50 × 400 ft. will be placed at the west end, having a depth of 30 ft. on the miter sill. The canal line crosses two ridges, the western one having an elevation of 314 ft.

The estimated cost of this project is $4,500,000, of which the auxiliary works will cost $500,000.

A party of St. Louis capitalists, accompanied by their engineer, Col. Henry Flad, are now on the ground investigating the scheme. Yours truly,

Eugene Ricksecker.

Seattle, Wash., Feb. 12, 1895.

LUCAL OIL AS A SUBSTITUTE FOR LINSEED OIL IN PAINTING.

Sir: In your issue of Jan. 24 appeared a summary of a talk delivered by Mr. Samuel Wallis, before the Association of Engineers of Virginia, on the important subject of the proper painting of wood and structural iron work.

His suggestion that the most careful scrutiny should be given all materials, both pigments and oils, is heartily indorsed. Some of the statements appear, however, to be slightly contradictory, and some are at variance with the observation of the writer and with what he understands to be the experience of a number of his acquaintances.

The inference to be gathered from the following statement is, perhaps, that the substitutes mentioned are inferior to linseed because they contain turpentine.

There are various substitutes for linseed oil, such as Sipes Japan oil, Lucal oil. etc., all of which contain some proportion of turpentine. While these are fairly satisfactory for a priming coat on wood, they should not be used on iron or for finishing.

It is not necessarily inferred that the turpentine is the only bad feature of these oils, but it seems to be in the mind of the writer of the quoted words that the turpentine is injurious. In spite of this he introduces in his formulas for priming and second coats 20% or more of turpentine or turpentine dryer.

In this he is doubtless justified, since the turpentine does not in any way injure the oil. It is used as a solvent by the manufacturers of varnish. It simply evaporates and leaves the gum of the oil behind. It is this gum that is, as the writer understands it, the life of the paint. Of course the more turpentine, the less gum in a given quantity of paint, and so it would seem that the omission of the turpentine would produce a paint of greater durability.

Again, after saying that these substitutes will answer for priming coats for wood, we find the following statement:

The priming coat is of the utmost importance, and should be applied more carefully than the top coats. It is an axiom that paint is never better than the material it covers, and a poor priming coat under a good top coat is sure to give unsatisfactory results.

Whether these peculiarities are the result of the work of the summarist, or are merely apparent to the present correspondent, because of his limited knowledge of the subject, is not known to him.

Concerning the first quoted statement, the writer would say that he is not familiar with Sipes oil, but he has some knowledge of Lucal oil, and his observation of it, and the testimony of those of his acquaintances who have used it, have caused him to form a different opinion of its merits than that expressed in the item quoted. He has, indeed, thought so well of it that he has specified it on iron work as an alternative for linseed, and has almost arrived at that condition of mind that will compel him to specify it, to the exclusion of linseed, for a great variety of work, particularly outside iron work, or iron work that is to be buried in the walls of buildings.

The writer does not know how the oil is made, but he understands that it is a manufactured oil, and not a mixture of other oils. If this is true, it is not clear that the presence of turpentine in the oil would of itself be injurious, provided there is also present the necessary "body" in the shape of a fibrous and elastic gum. Whether this body is or is not present, the writer has no means of knowing, except to watch the indications of the results of the use of the oil. This he has done to a considerable extent, and he desires to mention some of the points in which he thinks the oil is superior to linseed, and to ask if he is wrong. His opinion is formed partly from hearsay and partly from his own observation of work done with the oil.

1. It wears longer than linseed.
2. It covers better than linseed.
3. It is far more elastic than linseed.
4. It requires from one-third to one-half less pigment than linseed.
5. It resists the action of acids and alkalies far better than linseed.
6. It does not wash off when rained on while fresh to nearly so great an extent as does linseed.
7. It does not run, sag nor "crawl" as does linseed.
8. It can be used in many cases without a dryer.

It will be noticed that these points cover all Mr. Wallis's requirements for a good paint, so far as the oil is concerned. Because of 1 and 4 it is economical to use. Because of 2, 3, 5, 6 and 7, it seems peculiarly adapted to iron work and railway work; to the painting of the metal roofs of stations and buildings in general; to the painting of cars and tenders, and to the painting of bridges. It will protect to a greater degree than linseed the bridge floors from the effects of the salt drippings of refrigerator cars and the acids of the stock cars. These two elements are becoming well known as destroyers of bridge floors.

The writer has hesitated to specify this oil exclusively only because of the well-known prejudice in favor of linseed, which prejudice he knows to be very excusable. He has, moreover, feared that with his limited knowledge of paints and painting, he might be making a mistake in specifying an oil not in general use and acceptance by practically all painters. He is well aware that there are many substitutes for linseed oil, and that they are almost all uniformly cheap, worthless materials; but he thought the case was different with Lucal oil, which is certainly not particularly cheap, and which seems to have the good qualities mentioned. If there is some evil quality unknown to the writer, he

would much like to have it pointed out before he goes further in his use of the oil.

It should be stated that one of the points mentioned is given on the authority of the manufacturers only. This is the item of the use of the oil without dryer, in which matter the writer has had no opportunity to observe results, and no information from persons who have had such opportunity. The other points are all from his own observation, or from testimony of those who have used the oil.

What painters call the "holding out" quality of an oil is shown to be possessed by Lucal to a much greater degree than by linseed, by the rather novel photograph enclosed. It is a photograph of two very bad brick fronts recently painted in Troy by one of the leading painters of the city as an experiment. One front was painted with Lucal and the other with linseed. The spotted front is the linseed front. Each has but two coats, and it is evident that the linseed front needs at least one more. The dark spots on the linseed front indicate the bricks into which the oil has soaked, leaving the pigment on the outside without gloss or anything to hold it in place. The photograph was taken by the writer, who would be very glad to have the benefit of the observations of Mr. Wallis or any others who may have used this oil.

Very respectfully, Wm. G. Raymond.

Troy, N. Y., Feb. 5, 1895.

NOTES AND QUERIES.

R. M. M. wants to know whether in the construction of the Chicago Drainage Canal, the effect of so much additional water on the Lower Mississippi has not been overlooked. He probably forgets that, compared with the flood poured down by the "Father of Waters," the Drainage Canal flow will be but an insignificant rivulet. Its estimated capacity is 600,000 cu. ft. per minute, or 10,000 cu. ft. per second. The maximum flow of the Lower Mississippi at flood stage may be taken as 1,800,000 cu. ft. per second at Memphis and 2,200,000 cu. ft. per second at the mouth of the Red River (Eng. News, April 19, 1890). Thus the contribution of the Drainage Canal will be less than ½ of 1% of the total flow.

THE SEWERAGE SYSTEM OF LOS ANGELES, CAL.

(With Inset.)

By Burr Bassell, Assistant City Engineer.

The City of Los Angeles is built upon both sides of a torrential stream, called the Los Angeles River, at a point 20 miles from its mouth. The corporate limits of the city may be described as a square, more than five miles on a side, containing 18,597 acres.

The lowest point in the city is at the southwest corner, with an elevation of 170 ft. above mean high tide, or 85 ft. below "Old City Datum," said point being in the old river channel, and its natural drainageway. The present river channel is dependent upon artificial means for the confinement of its waters. Its bed is 30 ft. higher at the point where it leaves the south charter boundary, than at the southwest corner of the city. This change of channel is probably due to the influence of a tributary, called the Arroyo Seco, which empties its storm-waters laden with sand, gravel and boulders from the mountains on the north into the very center of the city.

A low range of hills, locally known as the Santa Monica Range, extends east and west across the northern half of the city. The highest points of this range are 800 ft. above sea level. This difference in elevation of more than 600 ft. affords ample drainage, with some attending disadvantages.

The census of 1880 gave a population of 11,183, that of 1890, 50,395. A conservative estimate for 1894 is 70,000.

The first comprehensive plan for sewering the city was prepared in 1887 by Mr. Fred Eaton, M. Am. Soc. C. E., at the time city surveyor. It was designed on the separate system, with an outfall sewer to the sea, via the Centinela Rancho. His estimated cost of the internal system was $533,846, and for an outfall sewer to the ocean by the Centinela route, 11.5 miles in length, $466,154, making a total of $1,000,000.

Mr. Rudolph Hering, M. Am. Soc. C. E., reported favorably on Mr. Eaton's plans, and stated that the problem of designing a good sewerage system for the city presented no serious difficulties.

The plans under consideration provided for a population of 200,000, on the assumption that the average amount of sewage per inhabitant would be 100 gallons per day, with a maximum of 150 gallons for a portion of the time. As a minimum size, Mr. Hering recommended 8 ins., with grades not less than 1 ft. in 200. For sizes larger than 18 ins. diameter, brick was preferable to vitrified pipe. He advised perforated covers for manholes, to facilitate good ventilation, the placing of a trap between the sewer and the housedrains, and making provision for independent ventilation for the latter, and also automatic flushing in the case of small sewers with flat grades. The first plan proposed was adopted by the city council, but failed to receive the sanction of the citizens of Los Angeles.

Two years later, in 1889, Mr. Eaton presented a second and more elaborate plan for the sewerage and drainage of the city. In this the city sewers were on the combined system, the storm waters being conveyed in the same sewers as the house sewage. The storm waters, however, were chiefly to be discharged into the river and other natural watercourses, by overflow openings, in order that the size of the outfall to the sea might be as small as possible. The new plans included an outfall sewer to the sea via Ballona Creek. In discussing the comparative merits of the different routes for an outfall sewer, Mr. Eaton stated, in his report, that the Ballona route was the natural outlet and also the most economical, but that the Centinela and Inglewood routes offered the best facilities for sewage irrigation.

In enumerating the objections to using the Los Angeles river-bed as a waste-waterway, Mr. Eaton called attention to the following: That the river flows on private property outside the city limits; that it has no well-defined channel; that there is never sufficient water in the river to dilute the sewage, except during the winter floods, and even then the water seldom reaches beyond a point 3½ miles south of the city; and, finally, that there was no precedent to justify the city in discharging its sewage into a dry river-bed.

The late Mr. P. J. Flynn, M. Am. Soc. C. E., one of Mr. Eaton's advisers, stated in an article defending an outfall sewer to the sea, that the same was indorsed by Messrs. Hering and Waring, two eminent sewerage experts. He also called attention to the following conditions, none of which here exist, as being necessary to pollution of the beach:

(1) A continual discharge of sewage.

(2) An indented or broken shore line.

(3) A gently sloping beach, leaving a wide foreshore with a sluggish current or no tidal current.

Mr. Eaton estimated the cost of three main intercepting sewers at $294,000, eleven storm sewers at $546,000, outfall sewer, Ballona route, 13 miles, $440,000; making a total of $1,280,000.

The cost of this latter plan being greater than the first, the citizens failed to vote the necessary bonds and the scheme was abandoned, like the first.

Immediately following the defeat of this proposition, the city council referred the matter of drainage of the city to a citizens' committee, which suggested a plan substantially the same as that of 1887 for the city sewers, but proposed to dispense with the outfall sewer to the ocean. Instead of the latter, they favored treatment of sewage by precipitation, filtration and otherwise, at different stations, and the use of the effluent for irrigation on lands south of the city. The estimated cost given by this committee was very much lower than either estimate of 1887 or 1889.

In December, 1889, the city council referred the matter of the city's sewerage to a commission of engineers, consisting of Messrs. Rudolph Hering, Geo. C. Knox, Fred. Eaton, August Mayer and Geo. Hansen. The last-named gentleman declining to serve, the remaining four, after reviewing at length the two plans proposed by Mr. Eaton and the various propositions submitted from time to time, reported substantially as follows:

That in the treatment and disposal of the sewage, the city could not afford to make experiments with patented processes, and that the quantity of fertilizing matter in sewage is small apart from the water in which it is carried, that it never pays to abstract it, and the problem resolves itself into the disposal of polluted water in a manner that shall not cause a nuisance.

The following five methods of sewage disposal were then presented and discussed:

(1) Straining the sewage through coarse strainers.

(2) Coarse filtration through artificial filters, or subsidence in tanks.

(3) Chemical precipitation.

(4) Disposal on land by (a) intermittent filtration, (b) irrigation.

(5) A discharge into the sea or some watercourse.

It is not thought necessary to give the discussion of the first three methods, as being clearly undesirable for this city. In regard to the fourth method of disposal, by irrigation, the twofold use of land, one for cultivation, the other for purification only, was mentioned.

Los Angeles, at the time of this report (December, 1889), had the most extensive sewage farming of any city in the United States, the sewage of about 17,000 people then being applied to about 1,700 acres south of the city.

The estimates of cost, presented by the commission, were based upon the requirements of first-class work throughout, the demands of a population of 200,000 people, and a daily amount of sewage equal to 20,000,000 gallons, with a maximum flow at the rate of 30,000,000 gallons.

The following three routes to the ocean were presented:

	Estimated cost.
River route to Long Beach, 20.5 miles	$1,035,800
Centinela route to ocean, 11.5	787,400
Ballona route to ocean, 13.0	690,775

Assuming that the city would be obliged to dispose of its sewage for 130 days in the year, by means of intermittent filtration, the following estimates were made:

For station near river for entire city	$735,400
For station near Ballona Lake for entire city	856,000
For two stations, one at river and one at Ballona	779,000

The following were the estimated cost for chemical precipitation plants:

For river station	$491,900
For Ballona station	542,300
For two stations as above described	681,000

The above estimates are of interest, when compared with the actual cost of both the city sewer system and the outfall sewer hereinafter presented.

The commission followed this branch of the subject with numerous conclusions, the most important of which may be briefly stated as follows:

The city has no available stream into which crude sewage may be discharged. The cost of purifying the sewage by precipitation is too great to cause the process to be recommended. The city cannot guarantee the public against the creation of a nuisance, unless in a position to dispose of the sewage properly at all times.

An outfall to the sea, requiring a minimum of care and attention, is to be preferred; it will create no nuisance on the beach, and the income from the sale of sewage along the line of an outfall during the irrigation season will amount to over 3% of its cost, when the population reaches 200,000.

The second main head, or division of the report, the city sewer system, was considered under two subheads: (1) The sewerage system proper, and (2) the storm-water system. In discussing the first, it was remarked that it is usually found cheaper to concentrate the sewage as fast as possible into mains and interceptors, in order to reduce the size of the numerous branch sewers and avoid the construction of a great number of large sewers.

The commission enumerated three interceptors and three main branch sewers, as all that would be required at first in order to reach the populated districts. These sewers aggregated 16 miles in length and were estimated to cost $374,000.

In considering the subject of storm-water removal, the commission had an ocular demonstration only a few weeks before concluding their report, convincing them that storm drains for the lowest streets of the more populous districts were an urgent necessity, many of the streets being streams of water spreading from curb to curb.

The commission was furnished a record of the heaviest storms which had occurred in Los Angeles from 1878 to 1889, by Mr. Franklin, of the U. S. Signal Service, from which the following condensed table has been prepared, giving the years in which the precipitation equalled or exceeded 2½ ins.

in 24 hours or less, the number of times in each year and the amount in inches, as follows:

Year.	No. times.	Precipitation, ins.
1878	1	3.58
1879	2	7.75
1884	5	15.28
1886	1	3.77
1887	1	3.94
1888	2	6.11
1889	3	10.45

This gives an average of 3.39 ins. of rainfall occurring 15 times during the past 11 years. During the same period there were eight downpours in which the precipitation averaged 1.08 ins. in one hour or less. From this record the commission concluded:

(1) That the rainstorms are not as heavy as in the Eastern states; and (2) that the maximum intensity of fall in one hour did not vary greatly.

It was suggested that storm-water drains be built as soon as practicable, intercepting the water along its natural courses and discharging into the river or ravines along the nearest lines. There were eight such drains recommended, estimated to cost $512,900.

The call of the city council for a bond issue amounting to $374,000 for intercepting and main sewers was carried by popular vote March 13, 1890; a call for a bond issue, amounting to $527,900, for storm drains was lost on the succeeding day, and on March 15 the people also voted against the proposed issue of $696,775 of bonds for an outfall sewer.

Details of the character, extent and cost of the main and intercepting sewers built in Los Angeles since the above bond issue was authorized, are shown by Table I.

The least velocity allowed in any of the sewers built since 1886 is 2¼ ft. per sec., and the smallest size sewers are 8 ins. in diameter. Little difficulty is found in obtaining self-cleansing velocities. Manholes are placed 300 ft. apart on an average, always at point of change in alinement or grade. An automatic flush-tank is built at the dead end of every sewer, having a capacity of about 300 gallons, supplied from the street mains and discharging automatically when filled. They are arranged at present to flush once in every 24 hours.

The style of flush-tanks in use is known as the Miller Automatic Siphon. The friends of the Van Vranken patent are urging the city to make a trial of their flush tanks, and it is to be hoped that a fair test may be given. The average depth of sewers in the residence portion of the city is 10 ft., and in the business section 13 ft. Maps and profiles, showing the exact location and elevation of manholes, lampholes, flush-tanks, Y's for house connections, etc., are of record in the city engineer's office.

TABLE I.—Main and Intercepting Sewers Built in Los Angeles after the Bond Issue of 1890.

Name of sewer.	Material.	Size, ins.	Length, ft.	Cost.	Remarks.
Central interceptor	Brick, circ.	36 to 50	23,326	$124,471	Brick sewers, two rings; mortar, 1 cement to 2 sand; outside plaster 1 to 3, inside 1 to 1.
" "	Vit. pipe.	15 to 30	14,410	46,526	
" "	Cast iron.	36	396	4,907	Crossing river, anchored between two lines of piles.
			38,132	$175,904	
Western interceptor	Vit. pipe.	15 to 30	22,086	53,319	Manholes, 4 ft. diam.; chambers, 9 × 12 ft.; Y's, 6 ins.
Southern "	" "	24	3,758	10.285	Laying, 70 cts.; manholes, $55; 24-in. pipe, $1.80; Y's, $7.12.
Arroyo de los Reyes	" "	15 to 24	18,206	41.972	Laying, 66 cts.; manholes, $80; 20-in. pipe, $1.26; Y's, $4.98.
Mozart St. sewer	" "	18 and 20	4,456	8.742	Laying, 55 cts.; manholes, $50; 18-in. pipe, $1.14; Y's, $4.35.
Hollenbeck Arroyo	" "	15 to 20	6,091	11,387	Laying, 71 cts.; manholes, $75; 15-in. pipe, 86 cts.; Y's, $3.35.
Totals			92,729	$301,639	17.56 miles built during 1890-92.

The branch sewers on lateral streets are being rapidly extended since the completion of the outfall sewer, there being about 8,000 house connections at the present time. An approximate estimate of the branch sewers shows an aggregate length of 50 miles, making a grand total, including trunk sewers, of 66.64 miles at the close of 1894.

The main intercepting sewers having been constructed, an outfall sewer became a pressing necessity. Mr. J. H. Dockweiler, the present city engineer, under instructions from the city council, resurveyed and mapped the present outfall sewer to the ocean, via Hyde Park and the town of Inglewood. This route, known as the Inglewood, was adopted, and bonds amounting to $395,000, the city engineer's estimated cost, were voted Nov. 1, 1892.

Plans and specifications were prepared by the city engineer's office as promptly as possible. Figs. 1 and 2, on the inset, show the location and profile, respectively, of the outfall sewer, as actually constructed, and require no extended explanation.

The sewer, which is 12.4 miles long, commences at the corner of Grand Ave. and Jefferson St., within the city, and follows Jefferson St. to Wesley Ave.; thence through the Agricultural Park to Vernon Ave., thence in a southwesterly direction, via Hyde Park and the town of Inglewood, to the Pacific Ocean. This terminal point is about midway between Redondo Beach and Santa Monica, coast towns twelve miles apart.

The city secured only a 15-ft. right of way along the line of the sewer, but obtained by purchase 230 acres of land at the terminal point, affording an ocean frontage more than a mile in length.

The capacity of the present outfall is about 32 cu. ft. per sec., equivalent to 20,736,000 gallons per 24 hours, with a calculated velocity in the 40-in. brick conduits of about 3.6 ft. per sec. The portion of the outfall within the city limits is 52 ins. in diameter, but without the limits, changes to two 40-in. brick conduits, only one of which has been built. Provision has been made at all the structures along the line for the second conduit.

The entire length was divided into ten working sections, of varying lengths, and separate bids were asked for each section complete. The profile, Fig. 2, gives the length and size of the different conduits, and the location of the 72 structures built. Sections Nos. 3 and 6 A are inverted siphons of wooden stave pipe, 38 and 36 ins. internal diameter, respectively. The west portal of the last tunnel is on the ocean front, and the bottom of structure No. 72, the end of Sec. 9, is about 58 ft. above mean high tide, the datum plane for all elevations. The last section, No. 10, consists of a single line of 24-in. cast iron flanged pipe, 1,200 ft. in length. It extends 600 ft. into the ocean and rests upon the bottom unanchored and unprotected, its outer end being in about 20 ft. of water. The pipe was bolted together with a ring of pure rubber between each joint, ¾ in. square. This gave sufficient flexibility to the line to admit of the following method of launching, which is shown fairly well by the photograph, Fig. 11, in the text, taken at the time by the writer.

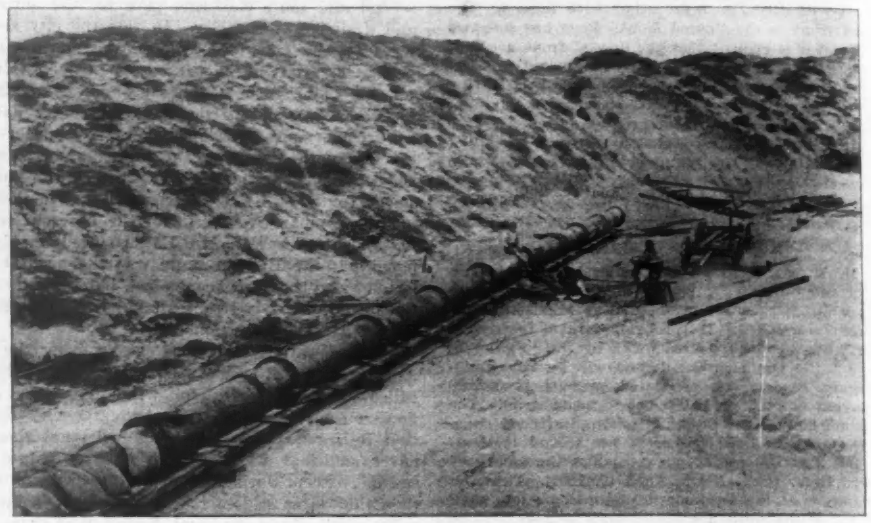


FIG. 11. VIEW OF OCEAN END OF LOS ANGELES OUTLET SEWER READY TO LAUNCH.

Six hundred feet of pipe, more or less, were first bolted together and placed upon two lines of horizontal timbers, one on either side, securely fastened to the pipe. Under these stringers, wooden rollers were placed upon two lines of 2×12 in. boards laid upon the ground. This whole line was slowly moved out to its proper position by means of two capstans, turned by horse-power. The sloping shore front greatly facilitated this manner of launching the pipe.

Structure No. 15 (see profile), Fig. 3 on the inset, was designed for a settling chamber, to collect the sand and other heavy foreign substances which might accompany the sewage and give trouble in the lower portions of the inverted siphons. It is built in four compartments, with brick walls, concrete bottom, and movable iron cover. The receiving chamber contains a vertical rubbish screen, extending entirely across the apartment and placed 4 or 5 ft. in front of the gates admitting the sewage into the middle apartments. This portion consists of two elongated sections 12 ft. wide by 36 ft. long, with a sand-pit 4 ft. deep below the grade line of the other apartments, and is covered with horizontal sand screens. When one pit has filled with sand, the sewage is turned into the other, while the first is being cleaned out. The remaining compartment is similar to the first described, with the rubbish screen omitted, and discharges into the first wooden stave siphon.

It was thought at time of construction that this chamber would not require cleaning out oftener than once a year, but after the experience of several months' use, it is found that large quantities of sand are deposited by the water from the river and open zanjas (irrigation ditches), and that this chamber will require frequent cleaning during the irrigating season. The heavy sand carries and holds the sewage in such manner that this chamber may have to be materially modified or else abandoned, to prevent its becoming an unmitigated nuisance.

I am of the opinion that this structure is useless, that it should be abandoned, or rather, be so modified that the sewage may pass on uninterrupted. All that is required is a long inclined rubbish screen, extending the entire length of the present chamber, so arranged that all drift material will accumulate at the siphon end of the screen on the bars high above the sewage channel, thus permitting the sewage to pass unobstructed through the screen below such accumulation.

The first siphon begins at the settling chamber and extends three miles to Hyde Park. It is 38 ins. in diameter, built of "black-heart" California redwood, with the sides of the staves dressed smooth and truly radial.

A detail view of a wooden stave is given on Plate 3, showing the saw-kerf, or slot, for the insertion of the hardwood tongue. These tongues, or wooden splines, were rectangular, 1½ ins. wide, ¼ in. thick and projecting ⅛ in. beyond the flank of the stave, so as to penetrate into the two adjacent staves of the pipe. The wooden splines have thus

far proven entirely satisfactory, and are believed to be better than the metallic tongues used in other places, which have shown signs of rusting out.

The bands were made of ⅝-in. round rods of medium steel, the specifications calling for steel with an ultimate tensile strength of not less than 60,000 lbs. per sq. in., and an elastic limit of not less than 35,000 lbs. The rods were threaded at both ends with 16 threads to the inch, Franklin Institute standard. Hexagonal nuts were used. The ends of the bands were seated in a cast iron shoe of the pattern shown on Plate 3. This shoe is known as the "Register Patent," and is faulty in, at least,

Fig. 12. View of Blow-off in Western Ave.

one respect, that the bands must cross each other, as shown in sketch, so that tension on the band produces a shearing strain in the shoe, resulting in the breaking off of the two projecting points.

It is thought by some that a mistake was made in the thread specifications, that they are too fine, many of them stripping off while being tightly cinched. Upon more careful investigation and experience it was found that the nuts were not uniformly and properly cut, and that this defect has been the cause of the trouble resulting from stripping.

The manner of constructing the pipe is shown fairly well in the photographic view in the text. The staves break joints and are driven lengthwise by means of wooden driving bars, no two adjacent butt-joints being nearer to each other than 2 ft. The bottom joints are kept in advance of the top, in the work of erecting. The bands were spaced uniformly 12 ins. c. to c.

The first construction gang should be followed by two sets of "back-cinchers," who should hammer the bands with strong wooden mallets while they are being finally cinched, seating the bands well into the staves. This precaution is one of great importance in making the pipe tight and preventing leakage. The staves should not be unnecessarily thick, for it is thought desirable that the water ooze through the same, keeping the pipe thoroughly wet and saturated, in order to prevent too rapid decay. It seems probable that the life of the staves may be made to exceed that of the bands, consequently all iron work was submerged in a hot bath of pure refined asphalt. How long the pipe may be made to last by renewing the bands from time to time remains to be seen.

Partial details of structures 21 and 44 A, typical of many similar structures having blow-off and hydrant connections, are shown by Fig. 6, on the inset, and Fig. 12, in the text. An 8-in. pipe, provided with a double gate straightway valve, placed outside the brickwork, is connected to the pipe by means of a cast iron saddle, bolted and banded to the pipe. Irrigating hydrants are attached, for the purpose of using sewage on the lands adjacent, when desired. The blow-offs were intended to facilitate cleaning and unstopping the siphons, should too much sand be admitted into the same. The experience thus far gained would seem to prove the blow-offs, as here designed, of doubtful utility.

In the structures Nos. 25 and 52, at the lower end of each siphon, are placed throttle valves, manipulated by a hand-wheel with toothed gearings, which admit of backing up the sewage and delivering the same under pressure at hydrants on high ground. The sections of the chamber, structure No. 25, are shown by Fig. 7, on the inset, and a view of the superstructure is shown by Fig. 13, in the text.

A view of one of the irrigating hydrants is shown by Fig. 14, in the text. The bell-shaped hydrant cover proved a failure, and has since been modified in form. As yet, no adequate provision has been made for measuring the discharge, and only an approximate estimate of the quantity of sewage delivered to irrigators is attempted.

Low hills are met with after passing Hyde Park, which required 5,789 lin. ft. of tunnelling on Secs. 4 A and 5 A. There are two other short tunnels, aggregating 2,184 lin. ft. (Sec. 9), passing through the sand dunes skirting the coast, making a total of 1½ miles of tunnelling. The material encountered was mainly sand, in many places very fine and difficult to handle. Water was met with on Sec. 4 A which necessitated pumping, but not in sufficient quantity to give trouble.

The only real difficulty experienced on the tunnel sections was in making the lagging perfectly tight. The fine dry sand would enter the smallest orifice, so that straw had to be used extensively to stop the leaks.

On Secs. 4 A and 5 A the average daily progress for excavating and timbering complete, with day and night shifts, was 8 lin. ft.

On Sec. 9 the material was not quite as fine and dust-dry as on the previous sections, and was under better management. The average daily progress here attained was 11½ ft. The average cross-section area of the excavation was 52 sq. ft.

The tunnels were lined throughout with brick and concrete, egg-shaped in section, 4½ ft. wide by 6 ft. high. They were made this size to carry the sewage of a second conduit when built. The semi-circular invert was made of concrete, 8 ins. thick;

Fig. 13. View of Structure No. 25, Showing Mechanism for Working Throttle Valve.

the remaining portion of two rings of brickwork.

The brick was of a superior quality, made of clay obtained near Inglewood, on the Centinela Rancho. The specifications called for "hard-burned brick, with a crushing strength of not less than 2,500 lbs. per sq. in." In the manufacture of the brick, the material was mixed and pressed by machinery, and kiln-burned. The brick cost $7.50 per thousand at the kiln.

The mortar and concrete were of the following composition: Mortar for brick masonry, 1 part cement, 2 parts sand; outside plaster, ½ in. thick, 1 part cement, 2 parts sand; inside plaster, ½ in. thick, neat cement; all concrete work, 1 part cement, by measure, 2 parts sand, 6 parts gravel.

There were 13,409 bbls. of cement used in construction, all of which was English Portland (Gillingham brand), furnished by the city, costing $2.90 and $2.95 per bbl. laid down at Inglewood and Hyde Park, respectively.

The brick and concrete work were both exceptionally good, doubtless due to the fact that the

Fig. 14. Irrigating Hydrant.

city furnished all the cement used, and also to the painstaking care of the Superintendent of Construction, Mr. H. P. Vincent, who saw that the specifications were complied with. Mr. Vincent insisted, in all cases, that the brick should be thoroughly wetted by immersion before using, and the writer knows, both from experience and personal examination of the work herein described, that compliance with this apparently small detail will cover a multitude of sins committed by the workmen.

The specifications stipulated generally that all tests of cement should be made by the methods and under the conditions prescribed by the Committee of the American Society of Civil Engineers. A Riehle Bros. testing machine of 2,000 lbs. capacity was purchased by the city, but the tests and records of the same were made in such a manner as to be almost worthless for comparative uses. The following table gives the average results for tensile strength in pounds per square inch:

Character.	No. samples.	Fineness, No. 50 sieve.	7 days.	28 days.	6 mos.
Briquettes neat cement..	290	95.20	361	473	826
1 cement and 1 sand....	..	....	....	....	565
1 " " 2 "	..	....	....	....	367
1 " " 3 "	..	....	....	....	246
Mortar (as specified)....	..	....	....	....	396

At the end of Sec. 5 A and the beginning of the second siphon is a drop of about 12 ft. A ground-plan and section of this structure, No. 41 A, are shown by Fig. 8, on the inset. This is at the head of the first 30-in. irrigation lateral, marked "Lateral No. 1" on the plan, being built by private landowners and now nearing completion.

A plan and section of structure No. 43 A, showing manhole and hydrant at angle point on the line of the second siphon, are shown by Fig. 9 on the inset. This angle is made sharp by means of a boiler-plate knee, the narrow 15-ft. right of way preventing the use of a curve.

Provision was made for irrigation laterals Nos. 2 and 3, at structures Nos. 46 and 50. A plan and section are given of these structures in Fig. 10, on the inset, showing the position of straightway valve and boiler-plate drum, connecting the laterals.

The gates are so arranged that sewage can be delivered to irrigators in such quantities and at such times as they may require, and during the "rainy season," when sewage is not wanted, it is allowed to pass on to the ocean.

The following summary of costs is believed to be correct to within $100 for each and every item:

Amount of bids	$266,691	
Law expenses	4,200	
Right of way	14,200	
Cost of cement used	39,900	
Cement testing	2,500	
Engineering	9,100	
Superintendence and inspection	19,500	
Right of way, damages and repairs	6,300	
Incidentals, sewer committee expenses, etc.	8,309	
		$370,700
Balance on hand		24,300
Amount of bond issue		$395,000

The city election voting bonds for the above amount was held, as has been stated, Nov. 1, 1892, and the outfall sewer was formally opened March 9, 1894.

Table II. shows the cost and character of the work with the names of the contractors for the various parts of the outfall sewer.

TABLE II.—Information Regarding the Various Sections of the Los Angeles Outfall Sewer.

	Name of contractor.	Contract price.	Construction—Begun.	Construction—Finished.	Length, ft.	Size and character of section	Barrels of cement used.	Remarks.
1	J. Rebman	$12,018	Jan. 25, '93.	Apr. 1, '93.	2,463	52-in. circular, two rings brick.	1,174	This section built large enough to carry the sewage of a city of 135,000 population.
2	Frick Bros.	24,085	Jan. 5, '93.	Mar. 17, '93.	4,435	40-in. circular, two rings brick.	1,734	Only one line built at present.
3	Mansfield & Grant.	39,000	Sept. 6, '93.	Feb. 8, '94.	16,936	38-in. wooden stave pipe.	49	Secs. 3 and 6A required about 700,000 ft. B. M. Cal. redwood.
4A	Mackay & Young.	31,033	May 25, '93.	Dec. 6, '93.	4,677	40-in. brick conduit and 6-ft. oval tunnel.		1,883 lin. ft. of brick conduit; 2,794 lin. ft. brick and concrete tunnel.
5A	" " "	30,091	Aug. 11, '93.	Nov. 10, '93.	3,842	6-ft. oval tunnel, 40-in. circular brick.	5,012	2,995 lin. ft. brick and concrete tunnel; 847 lin. ft. brick conduit.
6A	Mansfield & Grant.	38,450	Aug. 16, '93.	Jan. 10, '94.	17,174	36-in. wooden stave pipe.	72	All concrete, 1 cement, 2 sand, 6 gravel.
7	Frick Bros.	27,454	Apr. 10, '93.	Jun. 15, '93.	6,052	40-in. circular brick conduit.	2,292	All mortar for brickwork, 1 cement, 2 sand.
8	Hughes & Mayer.	24,602	Jun. 15, '93.	Sept. 16, '93.	4,778	40-in. circular brick conduit.	1,583	
9	Frick Bros.	29,223	Jun. 10, '93.	Oct. 11, '93.	4,000	40-in. circular brick and 6-ft. oval brick and concrete tunnel.	1,490	1,912 lin. ft. of brick conduit; 2,184 lin. ft. of brick and concrete tunnel.
10	Hughes & Mayer.	10,735	Sept. 25, '93.	Nov. 30, '93.	1,200	24-in. cast iron pipe.	3	Flanged pipe with pure rubber band between each joint.
	Totals	$266,691			65,628 = 12.4 miles.		13,409	

While not only germane to the subject of this paper the following facts regarding sewage irrigation in the vicinity of Los Angeles may be of interest:

The population of the section of country immediately south of the city, known as the Vernon District, having increased rapidly in recent years, landowners objected to sewage irrigation and obtained injunctions restraining the use of the same.

The sewage was mainly used for growing vegetables for the Los Angeles markets, and was applied to the land from open lateral ditches. During the rainy season there was more water and sewage than the land could assimilate. The ditches were not kept clean and the strong odor became a nuisance. Objections were also made to sewage irrigation, on the ground that it was detrimental to the health of the community, but the facts failed to support these objections. It will thus be seen that the problem of sewage disposal for the city, prior to the completion of the new outfall sewer, was one of perplexity. In its extremity, the city entered into a contract on Nov. 1, 1885, with the South Side Irrigation Co., to give to said company, for a period of 18 years, "all the sewage matter of every kind flowing through the San Pedro St. Sewer," the average amount being 3.585 cu. ft. per sec., equivalent to 180 miner's ins.

In order to fulfill its contract, this company had to extend its pipe line, conveying the sewage from the city limits several miles south, to lands beyond the Vernon District. This outfall is a 22-in. cement concrete pipe connected with the old system of sewers within the city, and will now have to be relaid or lowered about 10 ft. for a long distance, to connect with the new intercepting sewer.

The quantity of sewage used has been about 400 miner's ins., or twice the amount stipulated in the contract, and has been used on about 2,000 acres of land.

There are about 2,000 miner's ins. of river water distributed by means of the zanja system, or open ditches, and this irrigates about 8,000 acres, equivalent to 200 acres per sec.-ft. of water. The average annual rental for so-called dry land (without irrigation) is $2 per acre. The rental of the same land for agricultural purposes, using water for irrigation, is $12 and sewage $20 per acre.

The greater value of sewage for irrigating vegetables and other small products is apparent, and irrigators attribute its value as a fertilizer to the ease with which the minute fibers and rootlets absorb and assimilate the manurial ingredients of the same.

The writer is well aware that much of the data herein presented are of local interest only. His aim has been, however, to present the subject as fully as time at his command would admit, even at a sacrifice of brevity and wit.

THE DUTIES OF A CITY ENGINEER.

The duties of a City Engineer formed the subject of a late lecture before the students of the Engineering Department of Union College, delivered by Mr. Horace Andrews, City Engineer of Albany, N. Y. Mr. Andrews laid especial stress upon the importance of precise work, and as to the degree of precision requisite he recommended a study of the laws of the propagation of error, especially as set forth in Gordan's "Vermessungs Kundie," or surveying and its allied topics, a work easily translated by any one having a slight knowledge of German.

According to the lecturer, a City Engineer should be a good draftsman and should have a good knowledge of constructive work, especially as this work pertains to sewers and pavements, the details of water-works, bridges, etc. A knowledge of architecture is also desirable; but, as a rule, the City Engineer may content himself with constructive details, and it is much the best policy to leave the artistic side of this question to architects of experience. The same rule applies to the planning and maintenance of parks, if of any importance or size.

The preparing of specifications was especially dwelt upon, and the City Engineer was advised to make these out as if he expected the work to be done by a sharp and unscrupulous contractor. Sooner or later a contract will fall to a man of this class, and every safeguard for the city should be provided. The Engineer should always be perfectly fair towards the contractor, and should fix prices in the specifications for all work that may possibly be required; prices which will give the contractor a reasonable profit and no more. Claims for extra work should be avoided by trying to provide against every contingency. Good and faithful inspectors are one of the best aids a City Engineer can have, and the City Engineer should have absolute power in their appointment and dismissal. Mr. Andrews did not approve of the civil service system for choosing inspectors, which was formerly in vogue in Albany, but has now been changed to appointment by the City Engineer.

As the City Engineer is often called upon to make apportionment maps, it is important that he should work with very accurate instruments. His testimony on measurements may be rejected in court, unless he can show that his tape or chain has been compared with an official standard; consequently, Mr. Andrews recommends every City Engineer to send a tape to the Bureau of Weights and Measures, at Washington, D. C., to have it compared with the mural standard kept there. This official tape should be employed in checking the length of tapes constantly used in the field, and for no other purpose.

As the tendency of the times is to concentrate more and more power and responsibility in the Mayor of a city and to reduce the power of the Board of Aldermen, the lecturer thought it would be well to have the Mayor appoint the City Engineer absolutely, without confirmation by the Council or Aldermen. All applicants for technical positions should be examined as to their fitness by experts added temporarily to the municipal boards of civil service examiners, or state boards of experts might be made available for all cities in the state, in such cases. The employment of competent men as City Engineers, said Mr. Andrews, is more important than the exact form of city organization. If the Engineer fully understands his duties, the proper organization will follow.

ELECTRIC MOTORS FOR DRIVING MACHINE TOOLS.

We published last week the paper and discussion on the above subject at the February "Engineers' Evening" of the American Society of Mechanical Engineers. Mr. Geo. Richmond, who read the paper of the evening, sends us a letter which he has received since the meeting from M. Melotte, Engineer for the company which installed electric motors in the Government rifle factory, at Herstal, Belgium. Mr. Richmond's paper gave an account of the results obtained at Herstal and some additional information is given in M. Melotte's letter, which we condense as follows:

Since the electrical motors were first installed, the shop has been enlarged, and we have been forced to add a 350-HP. Willans engine, directly connected to a dynamo, and are now constructing a third dynamo, which will be operated by a Willans engine of slightly greater capacity. The power plant will then be able to furnish the shops with 5,000 amperes of current at 125 volts, instead of 2,400 amperes, as provided at the outset. The reason of this increase lies not only in the enlargement of the factory, but more particularly in the increase of useful work done by the workmen operating the machine tools.

At the outset the output was estimated at 150 pieces for each workman, but the establishment of the piece-work system so stimulated the workmen that the output was raised to an average of 300 pieces per day.

According to the instructions of the builders of the machine tools, these latter were arranged to have about 12 effective HP. on each shaft of transmission. As a precaution, we installed electric motors of 16 brake HP., but it was found a short time after getting to work that these motors were developing 30 HP., and one could see for four months these motors of 100 amperes working with loads varying from 200 to 300 amperes. You can imagine that they got warm, and that they sparked, but they worked nevertheless.

It was then decided to put more motors in, but as the shafts were very long, and had not been provided for this load, it was decided to cut them in the middle and place a motor at each end. We left in place the 16-HP. motor, and at the other end we placed a motor of 35 HP. This has been done with three or four shafts. On other shafts we replaced the 16-HP. motors with others of 25 or 30 HP. Finally, the factory has quite recently enlarged its cartridge room, which necessitates the new dynamos above referred to. I have omitted to mention also that the electric lighting system has been extended, which has absorbed from 300 to 400 amperes.

You see in what a difficult situation the gun factory would have been if, instead of this mode of transmission, it had adopted mechanical transmission. The difficulty of increasing the transmitted power would have been enormous, and it would have been necessary to remodel the whole. The first difficulty would have been to have had the transmission shafts capable of transmitting the increase of power. It would probably have been necessary to replace them with others proportioned to the work.

Since this installation I have had to calculate, and have constructed, other dynamos of the same kind at different speeds and power, going up to 600 HP., and those of high speed have always given the most satisfaction. Moreover, from the purchaser's point of view, they are altogether preferable, costing less and being more efficient than slow-speed dynamos. I should be in favor of these latter only for very large units, 1,000 to 1,500 HP.

As to the direct application of motors to machine tools, my opinion is that the heavy machine tools,

which take 1 HP. or more, could advantageously be operated by separate motors; but that when it is a question of small lathes or small milling machines the case is not the same, and here we must distinguish between the case where the tools have to work intermittently and where they are constantly occupied; in fact, if it is desired to put a motor to every tool we should have to use motors of ½ HP. or less, of which the efficiency is necessarily very small. If we group three or four of these machines together they could be operated by quite a small countershaft, driven by a motor of about 2 HP., from which one could get an efficiency of 70 to 75% without paying excessively for it.

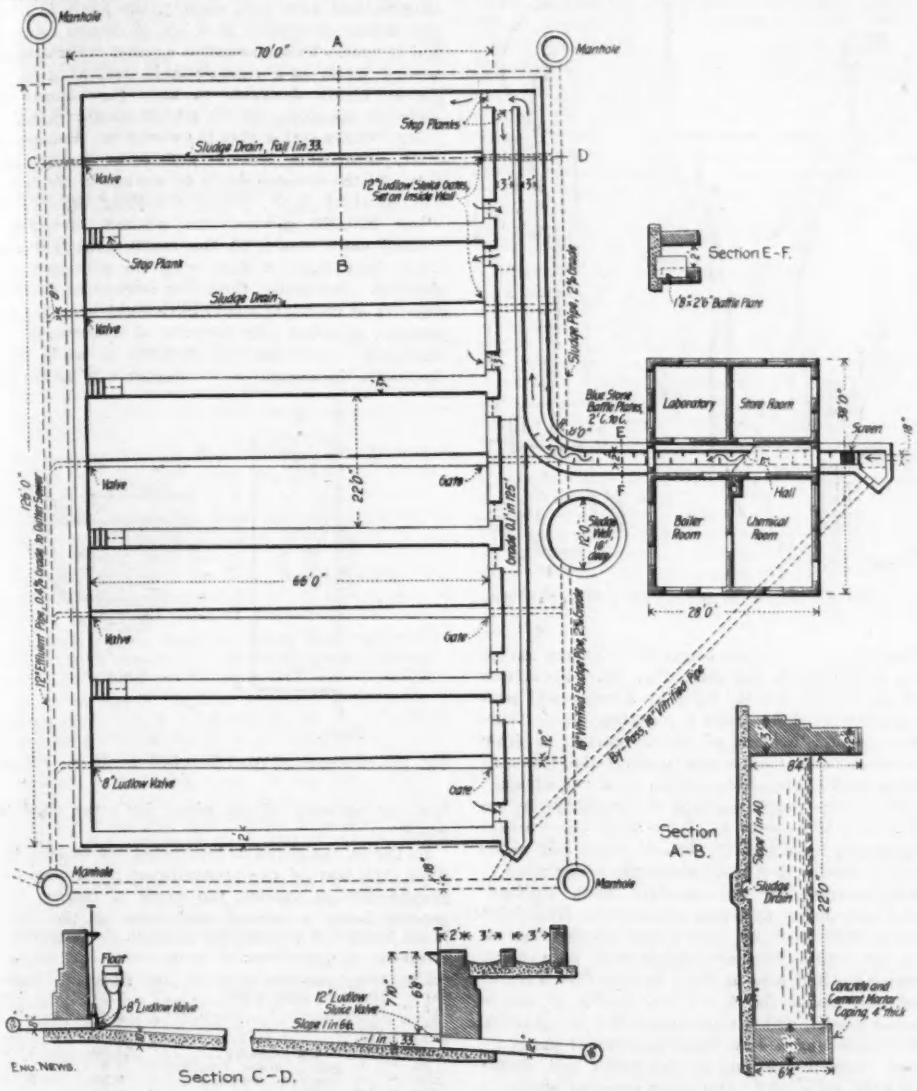


FIG. 105. PLAN AND SECTIONS OF SEWAGE PRECIPITATION PLANT; NEW ROCHELLE, N. Y.; J. K. Wickes, Assoc. M. Am. Soc. C. E., Engineer.

SEWAGE PURIFICATION IN AMERICA.

(Continued from Vol. XXII., p. 444.)

The Chemical Precipitation Plant, at New Rochelle, N. Y.

New Rochelle is a suburban residence village, located a few miles from New York, on Long Island Sound. The population of the village is now estimated at 10,000, the census of 1890 showing 8,217 inhabitants, and its area, on the mainland, is about 4 sq. miles. A ridge of land, running approximately north and south, divides the village into two sections, each of which has for its main surface drain a brook discharging east into an estuary connecting with the Sound. The tide here has a mean fluctuation of about 7 ft. and large areas of land are alternately exposed and covered with water. The only permissible methods of disposing of the sewage in its crude state, when it was proposed to put in sewers, appeared to be either to discharge it into the outgoing currents in the two estuaries during ebb tide, or to extend the outlet sewer far enough into the Sound to ensure the dilution of the sewage and to prevent its lighter portions being carried back to the shore. Before describing the plans finally carried out, some of the steps leading up to their adoption may be given.

First, it may be stated that a public water supply was introduced in 1885-7 by the New Rochelle Water Co., water being taken by gravity from an impounding reservoir on the Hutchinson River. In 1890, it may be added, a mechanical filtration plant was put in.

In 1888 eight sewer commissioners were elected, under Chap. 311 of the State Laws for that year. The commission organized on June 27 and later on contracted with Mr. Horace Crosby to make a topographical map of the village, which was completed on Sept. 15, 1888, at a cost of $1,650. Mr. J. J. R. Croes was then appointed consulting engineer and Mr. Crosby was engaged as engineer in charge of the work. On Dec. 18, 1888, the plans for a separate system of sewerage, with disposal into tidewater at the ebb, were approved by popular vote and the commissioners were authorized to incur an indebtedness of $275,000, of which $100,000 would be in the form of bonds and $175,000 certificates of indebtedness, to be paid by money raised from assessments for betterments along the line of the sewers. The plans were thereupon submitted to the State Board of Health for approval, and Mr. Emil Kuichling, M. Am. Soc. C. E., of Rochester, N. Y., was appointed to examine the plains and the locality affected.

Mr. Kuichling reported favorably on the pipe system, but pointed out that the proposed method of disposal was, in some respects, experimental in its details, which latter had not been fully worked out, owing to lack of time. This report was dated Dec. 14, 1888, and on Dec. 18 the State Board of Health approved the pipe system, but disapproved of the means of disposal shown by the plans. This was the storage of the sewage in covered and ventilated tanks or reservoirs, one for each of the two districts, of creosoted lumber, calked with oakum, the tanks to be located near the water and their contents to be discharged at the middle third of the ebb tide, through submerged 12-in. cast iron pipe lines into deep channels, one of these outlets being 750 and the other 1,100 ft. in length. The discharge of the reservoirs, Mr. Kuichling pointed out, would occur under an average head of 3 ft. during the two hours in question, in which time they would discharge 135,000 and 108,000 gallons, respectively. If the outlets should eventually be extended to 1,500 ft. in length, which Mr. Kuichling thought would not be improbable, the time of discharge would be increased, so that it would not come within the two-hour period.

As a temporary expedient the sewage from the Eastern District has been discharged, since May, 1892, into Echo Bay, through an 18-in. iron pipe placed 2 ft. below mean low water, with an alternative outlet at a second point. The commissioners state that the sewage gives no offence at these outlets.

Before work was begun on the second, or Western District, the legislature amended its act authorizing the building of sewers so that the sewage from this system had to be either purified or carried across the harbor to a point beyond the southerly shores of Glen Island and Davenport's Neck. Before beginning this work it was necessary to secure authority from the people to incur more indebtedness, which was effected by a popular vote on Aug. 23, 1892, authorizing $75,000 of bonds and indebtedness certificates to the amount of the cost of 8-in. sewers throughout the district. Mr. Crosby declining reappointment as Engineer, Mr. J. K. Wilkes, Assoc. M. Am. Soc. C. E., was ap-

FIG. 106. VIEW OF SEWAGE PERCIPITATING TANKS; NEW ROCHELLE, N. Y.

pointed as Chief Engineer and has since held that position. Purification was adopted and chemical precipitation was selected as the most available method. The disposal works were located in the southwest corner of the village, on Burling Brook, and from his plant the effluent is conveyed through an 18-in. pipe, about 5,000 ft. long, to tidewater, across the channel between the mainland and Glen Island.

The first plan was to discharge the effluent into Burling Brook, but so much objection was made that this was abandoned. Next the commission proposed to locate the disposal works at tidewater, thus making the outlet available for house and lateral connections all the way down, but property owners objected and finally secured legislation causing the effluent to be carried to tidewater from the present site. This outlet was expensive both for right of way and construction. Rock excavation, stone, concrete and pile foundations were required at points, and the last 940 ft. was laid with Ward flexible joints, this stretch and 276 ft. besides being of cast iron, while the balance was of vitrified pipe. The cost of this effluent outlet, estimated when work to the amount of $22,483 had been completed and measured up by the engineer, was

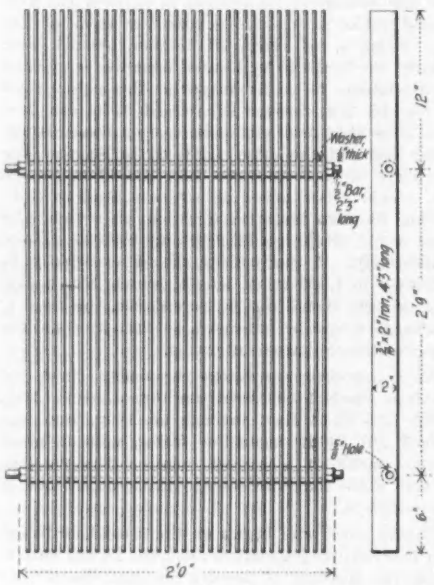


Fig. 107. Details of Sewage Screen.

$29,550, not including land for right of way or other purposes or legal expenses.

The accompanying illustrations show the construction of the plant in detail, the size of the various parts, and the general method of operation. Fig. 105 is a plan, with sections, and Fig. 106 is reproduced from a photograph of the precipitating tanks, the building and sludge tank being on the right, just outside the range of the camera. The plant is to be operated on the continuous plan. The sewage comes to the works through an 18-in. main sewer and passes through the screen shown by Fig. 107, after which it will receive lime and sulphate of iron and continue through the mixing channel with its 26 baffle plates (see detail in Fig. 105) and fall of 0.8 ft., and on into the precipitating tanks. The course of the sewage through the tanks is shown on the plan, Fig. 105. The stop planks can be used to cut out any tank for cleaning, at which time the effluent, after further settlement, is drawn out through the swinging effluent pipes shown by Figs. 108 and 109, the outlets being controlled by 8-in. Ludlow valves. Fig. 110 shows the wall brackets used to support the stems of these valves. By referring to Fig. 108, it will be seen that the floats for the swinging effluent pipes are fastened rigidly to the pipes, instead of being hinged to them, as is generally done elsewhere. The floats are designed to keep the mouth of the pipe continually submerged. The swivel joints for these swinging pipes were made by the Ludlow Valve Manufacturing Co., Troy, N. Y., and are like those used at Canton, O., and on the outlet pipe of one or more water-works reservoirs, where it is desired to draw water from varying surface levels.

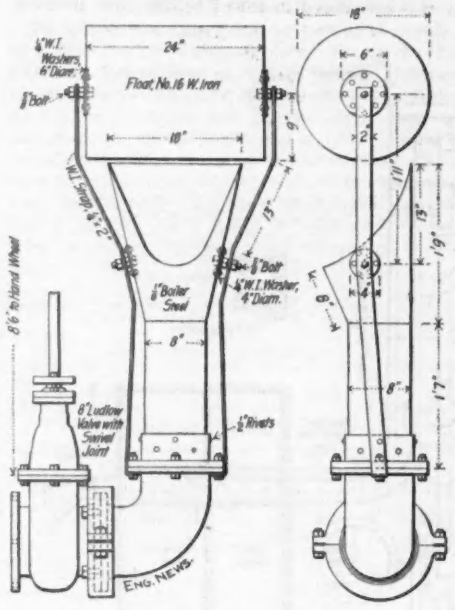


Fig. 108. Elevation of Swinging Effluent Pipes.

The sludge drains are connected with the sludge well, as shown in the plan, Fig. 105. From this well the sludge will be lifted by a pump and pass by gravity to sludge beds for drying, as at Worcester, Mass., instead of being treated in filter presses, as is common in other precipitation plants in this country. The sludge pump is a "Quadruple" vacuum steam pump, made by the Quadruple Steam Pump Co., 89 Liberty St., New York city. Steam is furnished by a 15-HP. vertical boiler and water is taken from a well just outside the boiler room.

The contract for the one-story brick building, tanks and sludge well was awarded to John New & Son, New Rochelle, who began construction on May 28, 1894. The excavation was in a hard, clayey loam and also in muck for the first 2 ft., in sand and gravel for 4 ft., and finally in water-bearing gravel, which necessitated the use of a 10-HP. engine and a 4-in. Bush centrifugal pump.

The concrete bottoms of the tanks and sludge well were made of 4 parts clean screened gravel, 2 parts sand and 1 part Taylor's American Portland cement, laid down in two courses. The bottoms of the tanks are covered with 1 in. of 1 to 1 cement mortar, having a float finish. The same brand of

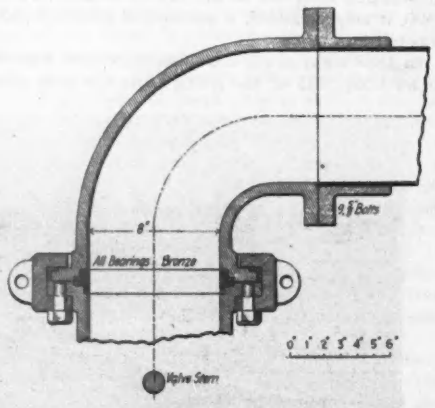


Fig. 109, Section Through Swivel Joint for Swinging Effluent Pipe.

cement was also used in constructing the tank walls, for which purpose nothing but selected hard-burned New Haven brick was employed. The centers of the walls are filled with 2 to 1 cement mortar, into which the water-soaked brick were forced, this feature being designed to prevent leakage, especially infiltration through the outer walls.

The by-pass shown on the plan, Fig. 105, can be used, Mr. Wilkes states, to convey the night flow of ground water past the plant without treatment. The vitrified sludge pipes are double thick, in 3-ft. lengths, and have 3-in. sockets, the joints in addition being surrounded by 6 ins. of cement concrete and mortar. This precaution against infiltration of ground water is a commendable one, as it is, of course, highly desirable to keep the amount of water in the sludge at the lowest possible point.

Mr. Wilkes states that the works are designed to treat, eventually, 750,000 gallons of sewage per day. As the average depth of sewage in the tanks will be about 5 ft., giving a holding capacity of about 270,000 gallons, the amount of sewage treated daily would fill the tanks somewhat less than three times a day, with no allowance for cleaning. Ordinarily, then, the sewage at the full capacity of the plant would have eight hours for its passage, provided only the rate of inflow could be regulated. For this no provision is made, but, doubtless, the amount to be treated will be far below the capacity of the plant for some time to come.

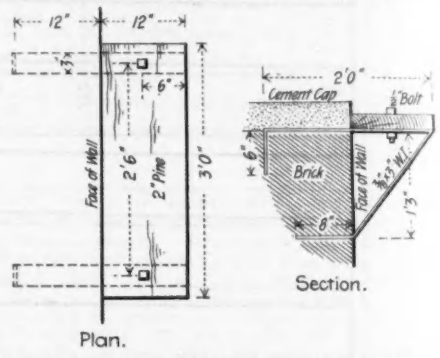


Fig. 110. Details of Wall Bracket at 8-in. Valves.

So far as completed or contracted for on Dec. 31, 1894, hte cost of the precipitation plant was approximately as follows, the items of fencing and grading being estimated, and most of the other items being the contractors' bids on the engineer's estimates of quantities:

160 ft.,	18-in. cast iron pipe.....at	$3.00	$480
400 "	18-in. vitrified pipe..... "	2.25	900
200 "	12-in. " " ..... "	1.50	300
30 "	8-in. " " ..... "	1.30	39
5 manholes		" 100.00	500
500 cu. yds.	brick masonry..... "	11.90	5,950
30 " "	rubble stone masonry "	2.85	85
350 " "	concrete masonry.... "	9.50	3,325
200 " "	broken stone ..... "	2.75	550
3,400 " "	earth excavation .... "	.30	1,020
5 8-in.	swinging effluent pipes,.... "	46.00	230
5 12-in.	Ludlow sluice gates..... "	32.00	160
60 bluestone	baffle plates..... "	.35	21
Iron screen			12
Building			1,691
Well			164
Pump and boiler			489
Fencing and grading (estimated)			825
Plans			25
Total			$16,766

Settlement with the contractor had not been made at the time of the report. Mr. Wilkes estimates the total cost of the plant at $19,000. In addition to this two acres of land and a right of way for the disposal works cost $3,990, including $390 for legal expenses.

The sewers in the town have been built on the separate system, with ventilated manholes provided with dirt pans. The total length of sewers in the Western District, including (it appears) the 5,000 ft. of effluent outlet, is 35,783 ft., or about 6.8 miles. In the Eastern District, but not connected with the sewage purification works described above, are about ten miles of sewers, again including the outfall sewer. The work up to Jan. 1, 1895, was carried out by eight commissioners, with Mr. John Q. Underhill as president throughout the whole period. Since the work on the Eastern District was begun Mr. Wilkes has been engineer to the commission, as stated above. We are indebted to Mr. Wilkes for all of the drawings and for much of the information from which this article has been prepared, and also to the report of the commission for some of the facts presented.

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PERSONALS.

Mr. Frank B. Francis, Surveyor, of Livonia, N. Y., died Feb. 17, at the age of 68.

Mr. F. B. Pelham, Assistant Engineer of the Michigan Central R. R., died at Detroit, Mich., recently, at the age of 30 years.

Mr. Bradford Dunham, Superintendent of the Alabama Midland R. R., has been appointed General Superintendent of the Plant system.

Mr. W. M. Hobbs has been appointed Division Superintendent of the Chicago, Rock Island & Pacific Ry., with offices at Horton, Kan.

Mr. Chas. O. Haines has been appointed Chief Engineer and General Superintendent of the Atlantic & Danville R. R., with offices at Portsmouth, Va.

Mr. J. H. Nelson, Engineer of the Home Supply dam, on the Big Thompson River, Colo., was recently severely injured by a fall from the work to the rocks below.

Mr. S. T. Earley has been appointed Roadmaster of the Sandusky Short Line Division of the Columbus, Sandusky & Hocking Valley R. R., with offices at Marion, O.

Mr. Arthur S. Tuttle, Assoc. M. Am. Soc. C. E., of Brooklyn, N. Y., delivered a lecture entitled "Notes on Sewerage" before the engineering students of the School of Engineering of the University of the City of New York on Feb. 21.

Mr. William Millar, Civil Engineer, died at Texarkana, Tex., Feb. 20, at the age of 71. He was formerly City Engineer of Kansas City, Mo., and at the time of his death was making surveys for a branch of the Kansas City, Pittsburg & Gulf Ry.

Mr. Gustave Davin, C. E., has been appointed Chief Draftsman of the Variety Iron Works Co., of Cleveland, O. He formerly had charge of the estimating department of Binder & Seifert's office, Chicago, and has been with the Phoenix, Keystone and American bridge companies.

Mr. Jacob S. Morris, Superintendent of the Toledo Division of the Pennsylvania Lines, died at Toledo, O., Feb. 18. He was born at Troy, N. Y., in 1838, began his railway career as a brakeman on the Pennsylvania R. R. in 1857, and in 1873 became Superintendent of the Toledo Division.

Mr. Joseph Wilkins, Jr., of Baltimore, Md., Assistant Engineer of the Baltimore & Ohio R. R. between Cumberland and Harper's Ferry, has been appointed Superintendent of the Washington County branch, vice Mr. J. R. C. Wrenshall, promoted to the Superintendency of the Philadelphia Division.

Mr. W. A. Stadelman, who has been with the Niles Tool Works for the last three years as special representative, has resigned to take a position with the Brown Hoisting & Conveying Machine Co., of Cleveland, O., and the Elwell-Parker Electric Co., of America, as their general Eastern agent, with headquarters in New York city.

Mr. Robert G. Fleming, Superintendent of the Georgia Division of the Savannah, Florida & Western Ry., died at Savannah, Ga., Feb. 20. He was born at Columbia, S. C., in 1838, and in 1855 was an apprentice in the shops of the Greenville & Columbia Ry. at Helena, S. C. He became Superintendent of the Port Royal & Augusta Ry. in 1873, and of the Savannah, Florida & Western Ry. in 1881.

Mr. E. G. Nourse has opened an office at 451 The Rookery, Chicago, as a consulting railway engineer. Mr. Nourse has had about 17 years' experience in general railway engineering on the Chicago, Rock Island & Pacific, the Atchison, Topeka & Santa Fe, and other railways, and was on U. S. government work at Rock Island rapids for about three years. He was Assistant General Manager of the Transportation Department of the Columbian Exposition.

Mr. J. W. Maxwell has been appointed General Superintendent of the Texas Division of the Missouri, Kansas & Texas Ry., with offices at Denison, Tex. Mr. A. D. Bethard will be Division Superintendent of the Fort Worth, Dallas, Henrietta and Denton divisions, and Sherman branch, with headquarters at Denison, Tex. Mr. T. S. McDowell will be Division Superintendent of the Waco, Houston, San Marcos and Trinity divisions and Belton branch, with headquarters at Taylor, Tex.

Mr. Philip Collins, a well-known railway contractor, and brother of the equally well-known contractor, Thomas Collins, died at his home in Ebensburg, Pa., on Feb. 24, aged 74 years. The Collins Bros. did much work for the Pennsylvania R. R. Co., and among their most successful enterprises may be noted the Sand Patch tunnel, near Cumberland, Md., which they completed after a number of other contractors had failed. They both lost fortunes in attempting to build a railway in Brazil, around the falls of the Madeira River, but they soon recovered from their losses by success on other works.

Mr. Royal E. House, who first conceived the idea of a printing telegraph, died at Bridgeport, Conn., on Feb. 25, at the age of 81. Mr. House was a native of Susquehanna, Pa. He was one of the early inventors in the United States, his first patent being numbered 1,200, and his last No. 533,600. In 1840 he invented a water-wheel embodying the principles of the modern turbine; and soon after Prof. Morse had taken out his electric telegraph patents Mr. House devised a machine which printed the despatch in Roman letters, at a speed of 50 words per minute, and a line on this principle was actually operated between New York and Boston. In 1844 the Morse Co. sued for an injunction, on the grounds of an infringement on their patents. The court decided that there was no infringement; but the discovery that the Morse message could be taken by sound caused the disuse of the more expensive House mechanism. Mr. House took out several patents for improvements in telegraphy.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
March 2. Secy., L. F. Rondinella, 1122 Girard St.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
March 4. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
COLUMBIAN ENGINEERING SOCIETY.
March 5. Secy., W. F. Hart, University Building, 15th and H. Sts. N. W., Washington, D. C.
WESTERN SOCIETY OF ENGINEERS.
March 6. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
March 6. "Timber Physics," by J. B. Johnson. Secy., W. H. Bryan, Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
March 6. Secy., C. W. Hunt, 127 E. 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 7. Secy., C. H McLeod, 12 Mansfield St., Montreal.
FRANKLIN INSTITUTE, PHILADELPHIA.
March 8. "Synthetic Work in the Class of Carbohydrates," by Mrs. H. A. Michael. Secy., W. H. Wahl, 16 South Seventh St., Philadelphia.
MONTANA SOCIETY OF CIVIL ENGINEERS.
March 9. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
INDIANAPOLIS ENGINEERING CLUB.
March 9. "Steel Construction in Architecture," by C. E. Hildebrand. Secy., C. C. Brown, City Engineer.
WISCONSIN POLYTECHNIC SOCIETY.
March 12. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
March 11. Secy., F. W. Tuttle, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 12. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 12. Secy., F. C. Osborn, Case Library Building.
NORTHWESTERN RAILWAY CLUB.
March 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
March 12. Secy., H. Breen, 36 Jacobson Block.
NEW ENGLAND RAILROAD CLUB.
March 13. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
March 13. "Rapid Transit in Large Cities," by W. B. Parsons. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
March 14. Secy., Jas. K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
March 14. Secy., H. D. Ruhm, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 15. Secy., D. W. Meeker, St. Paul, Minn.
ENGINEERS' CLUB OF MINNEAPOLIS.
March 18. Secy., E. Nexsen, Kasota Block.
WESTERN RAILWAY CLUB.
March 19. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 20. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
March 20. Secy., F. Van Vleck, Los Angeles, Cal.
BOSTON SOCIETY OF CIVIL ENGINEERS.
March 20. Secy., S. E. Tinkham, City Hall. Rooms, 36 Bromfield St.
NEW YORK RAILROAD CLUB.
March 21. Secy., John A. Hill, 256 Broadway, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
March 21. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
March 21. Secy., J. F. Wilson, Odd Fellows' Temple.
CENTRAL RAILWAY CLUB.
March 27. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
April 5. Secy., O. H. Van Geldern, 319 Market St., San Francisco.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 18. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on Feb. 16, Mr. C. H. Ott described an ingenious solution of a problem in hydrostatics, in Anniston, Ala. Mr. E. F. Miller exhibited a table showing maximum velocities, and corresponding pressure in pounds per sq. ft., of the wind in the neighborhood of Philadelphia for each month from 1873 to 1893. The highest pressure recorded was about 13¾ lbs. per sq. ft. L. F. Rondinella, Secy.

COLUMBIAN ENGINEERING SOCIETY.—The officers elected for the current year are as follows: President, Francis R. Fava, Jr.; Vice-President, W. G. Steward; Secretary, F. W. Hart; Librarian, W. H. Aspinwall; Financial Secretary, C. C. Jones. Regular meetings are held on the first and third Tuesdays of each month, at 8 p. m., in the headquarters, University Building, 15th and H Sts. N. W., Washington, D. C. F. W. Hart, Secy.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—At the regular meeting on Jan. 17 a statement from Mr. R. A. Parke, in discussion on the report on counterbalancing, abstracted in our issue of Jan. 17, 1895. He advocated making a counterbalance weight in the form of a segment of a circle, rather than that of a crescent, it being much easier to ascertain the weight and center of gravity of the former. In regard to the proposed revision of car interchange rules, Mr. A. G. Steinbrenner, Master Car Builder of the American Refrigerator Transit Co., stated that in many cases the railways do not properly repair damaged refrigerator cars, but leave the insulation in its damaged condition and merely replace the sheathing. Mr. Leeds remarked that care should be taken that the revised rules are not such as to be as obnoxious as those now in force. These, however, would not be so obnoxious if correctly understood and properly followed.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—The annual meeting was held at Cleveland, O., Feb. 19, 20 and 21, the proceedings being opened by an address of welcome from the Mayor, Mr. Blee, an address on the early history of electric lighting by Mr. C. F. Brush, and the address of the president, Mr. M. J. Francisco. The following papers were read: "The Storage of Energy Essential to Central Station Economy," by Nelson W. Perry; "A New Method of Measuring Illumination," by Prof. Houston and Mr. A. E. Kennelly; "The Correct Method of Protecting Electric Circuits," by W. E. Harrington; "Large Arc Dynamos," by C. N. Black; "The Monocyclic System," by Dr. Louis Bell; "Practical Demonstrations of Protecting Lines from Lightning," by A. J. Wurts; "Arc Carbons and the Rating of Arc Lamps," by L. B. Marks. The topic of "How to Light Large Cities" was discussed, and reports were presented by the Committee on Data, the Committee on Relations Between Manufacturing and Central Station Companies and the Committee on Rules for Safe Wiring. The report of the Finance Committee showed receipts of $5,997; expenditures, $5,450, and a balance of $549. The election of officers resulted as follows: President, C. H. Wilmerding, Chicago, Ill.; Vice-Presidents, Frederic Nicholls, Toronto, Ont., and E. F. Peck, Brooklyn, N. Y.; new members of the Executive Committee, E. H. Davis, Williamsport, Pa.; W. R. Gardner, Pittsfield, Mass.; George A. Redman, Rochester, N. Y., and J. J. Burleigh, Camden, N. J. The president reappointed Mr. George F. Porter, of New York, as Secretary and Treasurer. The next meeting will be held at Atlanta, Ga., in May or June, 1896.

ENGINEERING CLUB OF COLUMBUS.—This is a new society, recently organized at Columbus, O. It will hold meetings on the first and third Saturdays of January, February and March, and on the third Saturday of each other month, with the exception of July, August and September, when no meetings will be held. President, C. C. Wirte; Vice-Presidents, W. F. Kelly, and J. L. Firestone; Secretary, David Buell; Treasurer, E. C. Fuller.

INDIANAPOLIS ENGINEERING CLUB.—At the meeting on Feb. 23, Mr. Theo. Varney, of the Jenney Electric Co., read a paper on "Multiphase Currents of Electricity," in which he showed the principles of the different systems of multiphase transmission, and the advantages of the three-phase system. He also described the principal plants for long distance transmission. At the next meeting, on March 9, Mr. C. E. Hildebrand will read a paper on "Steel Construction in Architecture."

WISCONSIN POLYTECHNIC SOCIETY.—The following officers have been elected for the year 1895: President, Howland Russel; First Vice-President, Rich. Birkholz; Second Vice-President, E. M. Spalding; Secretary and Treasurer, Walter K. Means; Trustees, Geo. H. Benzenberg, John E. Hathaway and W. F.

Goodhue. The regular meetings are held at 8 p. m. on the second and fourth Tuesdays of each month, except July and August, at the society's rooms in "The Studio," No. 183 Third St. W. K. Means, Secy.

NEW PUBLICATIONS.

THE POCKET LIST OF RAILROAD OFFICIALS. Containing the names of officials in charge of railways, private car companies, fast freight lines and transportation companies of the United States, Canada and Mexico. Also showing the gage of each road, number of miles operated and rolling stock in service of each company. First quarter, 1895. The Railway Equipment & Publishing Co. New York. 12mo; pp. 292; published quarterly; $1 per annum.

The title of this handy volume indicates the purpose of its publishers. In these alphabetical lists of railways all names of officials are alphabetically arranged under the titles of offices held, and the address is given for each. The table showing miles operated, gage and rolling stock of each road, is a most convenient and useful feature; as is also an alphabetical list of all railway officials, with office and a reference to the system with which they are connected. A list of the national and state railway commissioners, Canada included, closes the volume. The tables are well and clearly printed, and being corrected quarterly they should be a safe guide to a very useful mass of information.

ADMINISTRATION REPORT ON THE RAILWAYS IN INDIA, 1893-94 (Part II).—By Lieut. Col. T. Gracey, R. E., Officiating Director General of Railways. Calcutta. 4to; pp. 452; 75 cts.

This report is mainly statistical and financial, and is as complicated and unsystematic as these reports usually are. The working expenses for all roads in 1893 were 46.62% of the gross earnings, or 45.22% for the standard gage (5 ft. 6 ins.), and 50.59% for the meter gage lines. The railway system in operation at the end of 1893 included 10,473 miles of standard gage, 7,443 miles of meter gage, and 266 miles of special gages (24 and 30 ins.), or 18,174 miles in all. There is a list of dimensions, cost, etc., of the principal bridges and tunnels, and also a statement of the character of track on the several roads.

AMERICAN INTERNATIONAL ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—Proceedings of the Fourth Annual Meeting, held in Kansas City, Mo., Oct. 16, 17 and 18, 1894. Secretary, S. F. Patterson, Concord & Montreal R. R., Concord, N. H. 8vo.; pp. 104; illustrated.

This volume contains the general proceedings of the meeting and the followng reports: "Depressed Cinder Pits," "Best Methods of Bridge Inspection," "Maintenance of Pile and Frame Trestles," "Best Track Scale Foundations."

TRADE PUBLICATIONS.

SIGNALING.—The Union Switch & Signal Co., Swissvale, Pa. 4to; leather; pp. 351, and 151 full-page plates.

There is probably no single department of railway operation and management in which such a remarkable advancement has been made during the past dozen or fifteen years as in the field of signaling. No longer ago than 1880, the interlocking of switches and signals and the movement of trains under the block system were confined to a very few large and wealthy railways in the East. The progress which has been made since that date is well illustrated by the large and handsome volume before us, the finest and most complete catalogue of railway signal apparatus ever issued in this country at least, and we know of nothing that compares with it among foreign publications.

The preface gives a very interesting summary of the work which this single company has done; and when the brisk competition which has prevailed is remembered some idea can be gained of the extent to which the introduction of modern practice in signaling has extended.

In the dozen years since the Union Switch & Signal Co. was organized, it has installed over 900 distinct plants of improved Saxby & Farmer interlocking machines, containing a total of over 16,000 levers. One railway company alone has 200 machines, with 4,100 levers, and another has 175 machines, with 2,200 levers. The electro-pneumatic interlocking machine has been installed by the company at 46 points, comprising 1,600 levers, and a large proportion of these plants are at important terminals. About 1,500 electro-pneumatic automatic block signals have been erected, and nearly 600 block instruments on the Union lock and block system are now in service.

The book before us is strictly a catalogue, intended especially for use in ordering either new equipment or duplicate parts for repairs, and descriptions of the devices are made as brief as possible, as the book is in no sense a technical treatise. Nevertheless, the full illustrations of detail parts make the book one which every signal engineer will wish to have for reference. The field covered is so wide that anything beyond very concise descriptions of the various devices is precluded by the necessity for a complete and accurate illustrated list of details. Special pains have been taken to assemble on consecutive pages those devices whose purposes are the same. In addition to the almost endless variety of block system instruments and signal equipment, switch and signal interlocking plants, and special devices in connection therewith (many of which have been illustrated and described in our columns), the company manufactures ordinary hand-operated switchstands, spring and rigid frogs, split and slip switches, and track crossings, among the latter being the "movable frog" and Fontaine crossing devices. The book is fully and handsomely illustrated by half-tone engravings of the various devices, and their detail parts, together with track plans of interlocking plants and views of about 20 of these plants, including those of the Pennsylvania R. R. and New York Central R. R. terminals in Jersey City and New York city. Lists of patents on the different systems are also given. The book is handsomely printed on good paper, and is provided with a comprehensive index.

PUMPS AND HYDRAULIC MACHINERY.—The Goulds Mfg. Co., Seneca Falls, N. Y. Cloth; oblong; 7⅛ × 8½ ins.; pp. 356; illustrated.

This is a very complete illustrated catalogue of pumps and hydraulic machinery for every kind of service, pump supplies, well tools, fire engines and fire equipment, etc. It is handsomely printed on good paper, and a good index makes it convenient for use. The pumps range from small hand pumps with 2-in. barrel, 0.07 gallon capacity per stroke and 25 ft. lift, to triplex pumps with 10-in. plungers, 17.6 gallons capacity per stroke, and 350-ft. lift. Numerous special types of pumps are shown, together with an improved hydraulic ram. The supplies include practically every appliance used in pump and well work, and several pages are devoted to useful information and tables. The book is unfortunately of an odd size and shape. In our issue of Feb. 21 we commented upon the advisability of manufacturers following the standard sizes in their catalogues and other trade publications.

ROAD MACHINERY.—American Road Machine Co., Kennett Square, Pa. Oblong 8vo; pp. 40.

This is an illustrated and descriptive catalogue of road machines of all kinds, including the Champion and American Champion road machines, the Champion rock crusher, the Champion horse road roller, and elevators, screens, drag and wheel scrapers, stone-distributing carts, etc. Some of these machines have been illustrated in our columns.

STREET CAR FENDERS.—R. A. Crawford Mfg. Co., Pittsburg, Pa. Oblong 8vo; pp. 24; illustrated.

Several different patterns of pick-up front fenders and truck or wheel guard fenders are shown. One of the latter was illustrated in our issue of March 8, 1894. It is stated that over 2,800 Crawford fenders were sold in 1894, the list of customers including 27 different street railways.

FOUNDRY CUPOLAS.—Whiting Foundry Equipment Co., Chicago, Ill. 8vo; pp. 16.

This is a descriptive catalogue of the Whiting cupola, showing the different types for different classes of service. Saving in fuel is claimed for these cupolas by the use of a softened blast tuyere, and the proportion of iron to coke, bed included, is about 10 or 14 to 1.

FEED-WATER HEATERS.—The Goubert Mfg. Co., 14 Church St., New York city. Paper; 8vo; pp. 40.

This illustrated catalogue contains descriptions of the Goubert water-tube feed-water heaters, surface condensers and the Stratton separator. Tables are given showing the economy of heating feed water.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Mar. 1.	Electrical subways,	Baltimore, Md.	Feb. 7
Mar. 1.	Removing shoals,	Detroit, Mich.	Feb. 7
Mar. 1.	Flagging (23 contracts),	Brooklyn	Feb. 21
Mar. 1.	Hydrants,	Cleveland, O.	Feb. 21
Mar. 1.	Canal excavation,	Butte, Mont.	Feb. 21
Mar. 1.	Retaining wall,	Paterson, N. Y.	Feb. 21
Mar. 1.	Water-works system,	Fort Plain, N. Y.	Feb. 21
	Advertised Eng. News, Feb. 21.		
Mar. 1.	Garbage disposal,	Pittsburg, Pa.	Feb. 21
Mar. 1.	Road bonds ($20,000),	Paterson, N. J.	Feb. 21
Mar. 1.	Sewers,	Rockville, Conn.	Feb. 28
Mar. 2.	Pump and boilers,	Willimantic, Conn.	Feb. 7
	Advertised, Eng. News, Jan. 31 to Feb. 21.		
Mar. 2.	Bridge,	Halstead, Kan.	Feb. 21
Mar. 2.	Sewer pipe, (245,000 ft.),	Medford, Mass.	Feb. 28
Mar. 2.	Bridge,	Prescott, Ariz.	Feb. 28
Mar. 4.	Water-works system,	Credo, W. Va.	Feb. 14
Mar. 4.	Artesian well bonds,	Abbeville, Ga.	Feb. 14
Mar. 4.	Pile dike,	Duluth, Minn.	Feb. 14
Mar. 4.	Court house work,	Bakersfield, Cal.	Feb. 14
Mar. 4.	Electric lighting,	Atlantic City, N. J.	Feb. 21
Mar. 4.	Paving sidewalks,	Houston, Tex.	Feb.
Mar. 4.	Iron foot bridges,	Paterson, N. J.	Feb.
Mar. 4.	Plans for court house,	Decatur, Tex.	Feb.
Mar. 4.	Exhibition buildings,	Regina, N. W. T.	Feb.
Mar. 4.	Wharf work,	Philadelphia, Pa.	Feb.
Mar. 4.	Cast iron pipe,	Wellsville, O.	Feb.
Mar. 4.	Removing grade-crossings,	Buffalo, N. Y.	Feb.
Mar. 4.	Electric lighting,	Fulton, Ky.	Feb.
Mar. 4.	Iron Bridge,	Gallatin, Mo.	Feb.
Mar. 4.	Brick paving,	Rock Island, Ill.	Feb.
Mar. 4.	Steam Engine,	Allegheny, Pa.	Feb.
Mar. 5.	Electric lighting,	Murfreesboro, Tenn.	Feb.
	Advertised Eng. News, Feb. 21.		
Mar. 5.	Gravel paving,	Terre Haute, Ind.	Feb. 21
Mar. 5.	Electric lighting,	Menasha, Wis.	Feb. 21
Mar. 5.	Boiler & eng'e,	Tompkinsville, N. Y.	Feb.
	Advertised Eng. News, Feb. 21 and 28.		
Mar. 5.	Levee work (227,000 yds.),	Shreveport.	Feb. 21
Mar. 5.	Brick paving,	Louisville, Ky.	Feb. 21
Mar. 5.	Exposition buildings,	Atlanta, Ga.	Feb.
Mar. 5.	W't iron water pipe,	Menasha, Wis.	Feb.
Mar. 5.	Water bonds,	Ashland, O.	Feb.
Mar. 5.	Railway ties, (150,000),	St. Louis, Mo.	Feb.
Mar. 5.	Laying water pipe,	Atlanta, Ga.	Feb.
Mar. 5.	Bridges,	Georgetown, Tex.	Feb.
Mar. 5.	Granite blocks,	Boston, Mass.	Feb.
Mar. 6.	Water-wks. system,	Ashland, O.	Feb.
	Advertised, Eng. News, Feb. 7 to 21.		
Mar. 6.	Pile bridges,	Plattsmouth, Neb.	Feb. 7
Mar. 6.	Brick pav.ng,	Sandusky, O.	Feb. 14
Mar. 6.	Sewers,	Cleveland, O.	Feb. 21
Mar. 6.	Channel excavation,	Cleveland, O.	Feb. 28
Mar. 6.	Brick paving,	Beverly, N. J.	Feb. 28
Mar. 6.	Sidewalks, etc.,	Buffalo, N. Y.	Feb. 28
Mar. 7.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
Mar. 7.	Paving (10 streets),	Cleveland, O.	Feb. 14
Mar. 7.	Gravel road,	Bloomfield, Ind.	Feb. 21
Mar. 7.	County clerk's office,	Oswego, N. Y.	Feb. 21
Mar. 7.	Pier work,	New York, N. Y.	Feb. 28
Mar. 7.	Sewer pipe,	Malden, Mass.	Feb. 28
Mar. 7.	Pipe sewers,	Erie, Pa.	Feb. 28
Mar. 7.	Timber,	New York, N. Y.	Feb. 28
Mar. 7.	Water-works system,	Rochester, Mich.	Feb. 28
Mar. 7.	Bridge,	Nashville, Tenn.	Feb. 28
	Advertised, Eng. News, Feb. 28.		
Mar. 8.	Highway bonds ($100,000),	Athens, O.	Feb. 14
Mar. 9.	Water-works system,	Clinton, Ky.	Feb. 21
Mar. 8.	Cast iron pipe,	Everett, Mass.	Feb. 28
Mar. 9.	School buildings,	Duluth, Minn.	Feb. 28
Mar. 11.	Water-wks. system,	Knoxville, Ill.	Feb. 7
	Advertised, Eng. News, Feb. 7 to March 7.		
Mar. 11.	Dredg'g and remov'g ledge,	Portland, Me.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Mar. 7.		
Mar. 11.	Water bonds,	Lafayette, Ind.	Feb. 14
Mar. 11.	Court house,	St. Joseph, Mich.	Feb. 14
Mar. 11.	Brick paving,	Monroe, Mich.	Feb. 21
Mar. 11.	Powder (150,000 lbs.),	Washington, D.C.	Feb. 28
Mar. 11.	Water-works system,	Coleman, Tex.	Feb. 28
Mar. 12.	Drains,	Mount Morris, Mich.	Feb. 14
Mar. 12.	Brick paving,	Peoria, Ill.	Feb. 14
	Advertised, Eng. News, Feb. 14 to 28.		
Mar. 12.	Pumping engine,	Dallas, Tex.	Feb. 21
	Advertised Eng. News, Feb. 21 to March 7.		
Mar. 12.	Sewers,	Peoria, Ill.	Feb. 21
Mar. 12.	Cast-iron pipe,	Toledo, O.	Feb. 21
Mar. 12.	Heating and vent'g app's,	Toledo, O.	Feb. 21
Mar. 12.	Lighthouse buildings,	Cleveland, O.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Mar. 13.	Boilers (18),	Cincinnati, O.	Feb. 21
Mar. 13.	Approaches at	Martinsburg, W. Va.	Feb. 21
	Advertised Eng. News, Feb. 21 and 28.		
Mar. 13.	School buildings,	Detroit, Mich.	Feb. 28
Mar. 13.	Brick sewers,	Hoboken, N. J.	Feb. 28
Mar. 13.	Sewers,	Cleveland, O.	Feb. 28
Mar. 13.	Brick and stone paving,	Cleveland, O.	Feb. 28
Mar. 14.	Masonry culvert,	South Bend, Ind.	Feb. 21
	Advertised Eng. News, Feb. 21.		
Mar. 14.	Improving streets,	Marion, O.	Feb. 21
Mar. 14.	Steel conduit (60-in.),	Allegheny, Pa.	Feb. 28
Mar. 14.	Street repairs, etc.,	Buffalo, N. Y.	Feb. 28
Mar. 14.	Dredging,	Buffalo, N. Y.	Feb. 28
Mar. 15.	Sewers (7 miles),	Bristol, Conn.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Feb. 28.		
Mar. 15.	Water-works system,	Port Hope, Ont.	Feb. 14
Mar. 15.	Pipe sewers,	Hamilton, O.	Feb. 21
Mar. 15.	Pipe sewers,	Richmond, Ind.	Feb. 28
Mar. 15.	Brick walks, etc.,	Richmond, Ind.	Feb. 28
Mar. 16.	Water-works system,	Evanston, O.	Feb. 21
Mar. 16.	Stone chapel,	Lancaster, O.	Feb. 21
Mar. 16.	Granite blocks,	Louisville, Ky.	Feb. 28
Mar. 18.	Steel bridge,	Atlanta, Ga.	Feb. 14
	Advertised, Eng. News, Feb. 14 to 28.		
Mar. 18.	Pumping engines,	Sacramento, Cal.	Feb. 21
Mar. 18.	Water bonds,	Caldwell, Idaho.	Feb. 28
Mar. 18.	Electric light bonds,	Caldwell, Idaho.	Feb. 28
Mar. 19.	Drains,	Mount Morris, Mich.	Feb. 14
Mar. 19.	Iron fence, etc.,	Riverside, O.	Feb. 21
Mar. 19.	Electric lighting,	Whitewater, Wis.	Feb. 14
Mar. 19.	County bridges,	Muscatine, Ia.	Feb. 28
Mar. 20.	Water bonds,	Port Hope, Ont.	Feb. 28
Mar. 20.	Bridge bonds,	New Westminster, B. C.	Feb. 28
Mar. 19.	Sewer,	Tallahassee, Fla.	Feb. 28
Mar. 19.	Water-works,	Muscatine, Ia.	Feb. 28
Mar. 19.	Water-works system,	Cuthbert, Ga.	Feb. 28
Mar. 20.	Subway,	Boston, Mass.	Feb. 21
	Advertised in Eng. News, Feb. 21 to Mar. 7.		
Mar. 20.	Power house, etc.,	Toledo, O.	Feb. 21
Mar. 20.	Dredging & rem'g rock,	Newport, R. I.	Feb. 21
	Advertised, Eng. News, Feb. 21 to Mar. 14.		
Mar. 20.	Paving (10 streets),	Cleveland.	Feb. 21
Mar. 21.	Gravel roads,	Anderson, Ind.	Feb. 21
Mar. 21.	Electric lighting,	Meridian, Miss.	Feb. 14
	Advertised, Eng. News, Feb. 14 to Mar. 14.		
Mar. 23.	Dredging,	Montgomery, Ala.	Feb. 21
	Advertised Eng. News, Feb. 21 to Mar. 14.		
Mar. 23.	Cement,	Montgomery, Ala.	Feb. 21
	Advertised, Eng. News, Feb. 21 to Mar. 14.		
Mar. 23.	Canal (6½ miles)	Ottawa, Ont.	Feb. 21
Mar. 23.	Sewer bonds ($50,000),	Cleveland, O.	Feb. 28
Mar. 25.	Water bonds,	Evanston, O.	Feb. 28
Mar. 25.	Water bonds,	Winton Place, O.	Feb. 28
Mar. 25.	Dam, etc.,	Cambridge, Mass.	Feb. 28
	Advertised Eng. News, Feb. 28 and Mar. 7.		
Mar. 25.	Water bonds,	Evanton, O.	Feb. 28
Mar. 23.	Brick paving,	Cincinnati, O.	Feb. 28
Mar. 26.	Street impvt. bonds,	Pleasant Ridge, O.	Feb. 28
Mar. 26.	Dredging plants,	Pittsburg, Pa.	Feb. 28
Mar. 27.	Plans for school bldg.,	Milwaukee, Wis.	Feb. 7
Mar. 27.	Smokestack, etc.,	Toledo, O.	Feb. 21
Mar. 27.	Bridge,	Toledo, O.	Feb. 28
Mar. 27.	Stone paving,	Cleveland, O.	Feb. 28
Mar. 29.	Bridge bonds,	Winnipeg, Man.	Feb. 21
Mar. 30.	Water-works system,	Pawling, N. Y.	Feb. 28
	Advertised Eng. News, Feb. 28.		

Apr. 1. Brick paving (20,000 yds.), Newark, O..Feb. 21
Apr. 1. Sewer, Keokuk, Ia.....Feb. 28
Advertised Eng. News, Feb. 28 and Mar. 7.
Apr. 1. Water bonds, Bancroft, Ia.....Feb. 28
Apr. 1. Tunnel sewer, Keokuk, Ia.....Feb. 28
Advertised Eng. News, Feb. 28 and Mar. 7.
Apr. 2. Dredging, Boston, Mass.....Feb. 28
Advertised Eng. News, Feb. 28 to Mar. 21.
Apr. 5. Electric light plant at Milwaukee, Wis..Feb. 28
May 15. Plans, etc., for bridge, Montreal .....Jan. 24
Advertised, Eng. News, Jan. 24 and 31.
No date. Cotton mill, Holyoke, Mass.....Feb. 28
Advertised Eng. News, Feb. 28 and Mar. 7.
" Water-works franchise, Barnesville, O...Feb. 28
Advertised, Eng. News, Feb. 28.
" Bridge, Belleville, Ont.....Feb. 28
" Macadamizing, La Grange, Ill.....Feb. 28
" Sewer pipe (30,000 ft.), Orange, N. J.....Feb. 28
Advertised, Eng. News, Feb. 28.

RAILWAYS.

East of Chicago.

ATLANTIC & LAKE SUPERIOR.—It is stated that the contract for building this railway between Longueuil and Lewis has been awarded to Messrs. Nicholas and Michael Armstrong, and that an additional 20 miles, known as the Baie des Chaleurs section, will be put under contract early in March. The proposed bridge across the St. Lawrence River is said to be planned in connection with this road.

CHATEAUGUAY & NORTHERN.—A charter has been asked by Eugene Malo, John Chaffers and P. Poulin, of Montreal, A. F. Savaria, of Waterloo, and Dr. Cartier, of Ste. Madeleine, for this company for the purpose of building a railway from Montreal to some point in Soulanges county, thence northeasterly across Montreal Island and continuing to some point on the Great Northern road in Joliette county, Que.; capital stock $200,000, all subscribed.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—The Louisville, Ky., "Courier-Journal" states this company has decided to build an independent road from North Vernon, Ind., to Louisville, and that the construction will be commenced at once and pushed as rapidly as possible.

DETROIT & MACKINAW.—Routes are being considered for the proposed extension of this railway to Bay City, Mich., according to press reports. Gen. Man. J. D. Hawks, Detroit, Mich.

ELKHART & WESTERN.—The work of building this railway will be resumed in a few weeks. The road is already into the suburbs of South Bend, Ind., but work was abandoned on account of the weather. It is expected that the road will be pushed on to Chicago by fall. It is rumored that the Illinois, Indiana & Iowa is backing the enterprise.

GRAND RAPIDS & INDIANA.—It is reported that an extension of the Lake City branch of this road, will be built the coming spring from the Grand Rapids Veneer Co.'s camp southeast 2¾ miles to Falmouth, Missaukee county, the work to be commenced as soon as the frost is out of the ground.

HARDWICK & WOODBURY.—It is stated that contracts will probably be awarded within a few days for grading this railway 4½ miles in length. L. D. Hazen, H. N. Turner and E. H. Blossom, of St. Johnsbury, Vt., H. H. Powers and Geo. M. Powers, of Morrisville, Vt., and C. A. Watson, of Woodbury, Vt., are among the incorporators.

MAINE CENTRAL.—A press report from Portland, Me., states that information comes from a reliable source that this company will build a branch road from Tomah Junction to Princeton, to connect with the proposed new Calais road, in which a well-known Portland capitalist is largely interested.

NEW YORK CENTRAL & HUDSON RIVER.—Bids are asked until March 4 for the following substructure work in connection with the removing of the grade crossings in Buffalo, N. Y.: Excavation, earth, 40,730 cu. yds.; loose rock, 455 cu. yds.; solid rock, 10 cu. yds.; piling in foundations, 5,360 lin. ft.; timber, 26,000 ft.; ironwork, 3,000 lbs.; concrete, 1,175 cu. yds.; first-class masonry, 395 cu. yds.; pier masonry, 135 cu. yds.; second-class masonry, 5,760 cu. yds.; third-class masonry, 1,580 cu. yds.; brickwork in cement, 10 cu. yds.; 12-in. tile drain pipe, 75 lin. ft.; coping stones reset, 10 cu. yds.; cofferdam; timber bridge for street traffic. Chn. Engr., Walter Katte, New York. Address H. Walter Webb, Third Vice-President, New York.

PITTSBURG, MONONGAHELA & WHEELING.—Incorporated in Pennsylvania Feb. 26, to build a railway 40 miles in length; capital stock, $1,100,000; Pres., Wm. G. Dacey, New York.

REDSTONE CONNECTING.—Incorporated in Pennsylvania Feb. 25, to build a steam railway from Redstone Creek, Jefferson township, Fayette county, to Perryopolis; capital stock, $100,000, commencing with $10,000; Pres., Jacob E. Ridgway, Philadelphia.

Southern.

DYERSBURG & MISSISSIPPI RY. & IMPROVEMENT CO.—This company has petitioned for a charter in Tennessee.

LAMAR, FONTAINE & SONS.—This company, of Clarksdale, Miss., is building nine miles of logging railway. The projected length of the road is 22 miles.

LITTLE ROCK & MEMPHIS.—A press report from Birmingham, Ala., states that the Kansas City, Fort Scott & Memphis, which owns the Kansas City, Memphis & Birmingham, has about closed a deal for the purchase of the Little Rock & Memphis road. It is proposed to extend the latter via the southeast corner of Indian Territory into Northern Texas. The Kansas City roads are heavy shippers of Alabama coal and the opening up of a direct line into Texas will put Alabama coal into that territory in great quantities.

PEACE RIVER PHOSPHATE CO.—Contracts have been awarded by this company, of Savannah, Ga., for building the first section of a railway from Arcadia, Fla., to Liverpool, 18 miles. This is probably the same project noted in our issue of Feb. 14.

PLANT SYSTEM.—A press report from Tampa, Fla., states that this company has a plan under way to develop the west coast of Florida by building a line from Tampa, north along the coast via. Homosassa to Cedar Key, about 110 miles. It is also proposed to build a railway from Tampa southeast to Fort Meade, about 45 miles, and the Tampa & Thonotosassa is to be extended from Thonotosassa north to Owensboro, about 30 miles. It is proposed to build large hotels at Homosassa and Cedar Key and also one at Clearwater.

SANTEE, WALTERBORO & PORT ROYAL.—This company has been incorporated in South Carolina to build a railway from some point on the South Carolina & Georgia to Port Royal, S. C. The construction of the road is not expected to be commenced until the financial situation has improved. The temporary directors elected at Charleston, Feb. 16, are: E. S. Wilde, E. B. Hollings, Geo. F. Von Kolnitz, D. G. Wayne, Jr., Geo. F. Von Kolnitz and L. A. Klauber.

SOUTHERN.—A press report from Louisville, Ky., states that the Louisville Southern will soon enter that city over a new route, which will be a system of viaducts, and will do away with grade crossings.

Northwest.

ILLINOIS CENTRAL.—This company is reported as preparing to build a branch to Egan, Ill. The right of way has been partly secured along the bank of Fox River from the main line at Coleman, four miles south of that city.

WISCONSIN & MICHIGAN.—A press report states that this company will soon make a preliminary survey for an extension of its line to Oconto next season, and ultimately to Green Bay. The extension of the road west to Merrill and Antigo is now certain, and on the north to Norway, tapping Menominee iron range. Over 200 miles of new track will be laid. The company has recently purchased the seven miles of railway, all equipments and dock privileges at Peshtigo, Wis., of the Peshtigo Lumber Co.

Southwest.

KANSAS CITY, PITTSBURG & GULF.—Congressman Tarsney has introduced a bill extending the time limit in the charter of this company for constructing a line in the Indian Territory. It provides that the company shall build at least 50 miles of its road in the Indian Territory before March 1, 1897, and complete the main line before March 1, 1899. The road is now under construction. The Texarkana & Fort Smith, noted below, is one of the links in its line between Kansas City, Mo., and Sabine Pass, Tex., on the Gulf of Mexico.

GAINESVILLE, McALESTER & ST. LOUIS.—A press report states that Senator Jones, of Arkansas, has made a favorable report on the bill to grant the Gainesville, McAlester & St. Louis Ry. Co. the right to build two branch lines through the Indian Territory. This is an amendment to the act of 1893, which authorized the construction of the main line. Both of the contemplated branches are to leave the main line near where it crosses Blue River. One is to run easterly down the valley of the Red River to the west line of Arkansas, at or near Ultima Thule. The other branch is to extend northerly through the Territory to the line of Kansas, near the town of Sedan.

LINK LINE.—Bids are asked until March 5 for the work remaining to be done on the Georgetown & Granger road, according to a press report from Georgetown, Tex., which states that the grading on the Georgetown & Granger R. R. has been completed, and bids will be opened March 5 for bridges and all other work on the road. The contract for the ties and bridge materials to be used in the construction of the road has been awarded the Reliance Lumber Co., of Beaumont. A similar contract was awarded the same firm for work on the Trinity, Cameron & Western R. R. from Georgetown to Davilla, in Milan county. The delivery of material was to commence Feb. 20. M. P. Kelly, Supt. of Const'n., and Capt. Emzy Taylor, Pres., have gone to New York to negotiate the sale of bonds and purchase rails and motive power for the Georgetown division of the Link Line. Blank contracts and specifications for the work on the Trinity, Cameron & Western have been distributed to contractors, and work on that end will be pushed rapidly. This railway was described in our issue of Feb. 7.

TEXARKANA & FORT SMITH.—Bids are asked until March 5 for the delivery of about 150,000 standard oak cross-ties for construction of the Texarkana & Fort Smith Ry. in Sevier and Polk counties, Ark.; bids covering a part of the above territory and for a proportionate number of ties will be considered; deliveries to be made at the rate of about 30,000 per month, beginning March 15, and proportionately by each subcontractor, in case it is found advisable to divide the territory. Central Coal & Coke Co. W. L. Whitaker, Man. Ry. Tie and Timber Dept., 703 Houser Bldg., St. Louis, Mo.—Monroe, Strang, Lee & Co., Texarkana, Ark., have awarded the following contracts for 50 miles of heavy work, including grading and masonry, on this road, as advertised in Engineering News Feb. 7; work to be commenced at once and pushed as rapidly as possible:

	Sections
R. M. Quigley, St. Louis..	58, 59, 60, 61, 62, 68.
Cruch & Murphy, Harrington, Kan.	63, 64, 65, 66, 67.
McCarthy & Cassidy, Little Rock, Ark.	69, 70, 71, 72, 73.
Mitchell & Co., New York.	74, 75, 76, 77, 78.
J. C. Donaghue, New York.	79, 80, 81.
W. A. Shippy, Friar's Point, Miss.	83, 84.
Ferguson Contracting Co., Friar's Point, Miss.	82, 85, 86, 87, 88.
Tim Ryan, Kansas City, Mo.	89, 90.
Patrick Foley, Kansas City, Mo.	91.
Murtaugh & Co., Kansas City, Mo.	92, 93, 94.
Thos. Lovett, Kansas City, Mo.	95.
S. M. Bush, Osceola, Ark.	96, 97.
Bird Stebbins, Osceola, Ark.	98, 99, 100.
M. M. Tighe & Co., Little Rock, Ark.	101, 102, 103, 104, 105, 106, 107

Rocky Mt. & Pacific.

CREEDE & GUNNISON SHORT LINE.—It is thought that this railway, which was surveyed in 1893, will be built this year. The road will probably connect with the Denver & Rio Grande at Wason, Colo., and run up Bachelor Mountain on a 4% grade to the producing mines at the top, and will eventually be extended on to Gunnison, about 40 miles further.

DELTA, NEW WESTMINSTER & EASTERN.—Incorporated to build a railway from the Gulf of Georgia to New Westminster, B. C., with a branch line from some point in Delta municipality, through Surrey, Langley and Matsqui, to Abbotsford.

SANTA FE, PRESCOTT & PHOENIX.—The formal opening of this railway has been set for March 11. The road runs from Ashfork, on the Atlantic & Pacific, to Phoenix, Ariz., the entire length of the line being 197 miles. The stockholders include N. K. Fairbanks, Chicago; D. M. Ferry, M. R. Bowen, and Simon Murphy, Detroit; Charles Arms, Youngstown, O., and Walter Hadley, Las Vegas, N. Mex. Pres., F. M. Murphy; Gen. Man., G. W. Vaughan. The Santa Fe route has established traffic relations with the new road and will at once issue tariffs to Phoenix, via Ashfork.

STREET AND ELECTRIC RAILWAYS.

THOMASTON, ME.—J. E. Vinal, N. B. Eastman and J. M. Studley, of Warren; S. H. Allen, J. E. Moore and W. C. Mehan, of Thomaston, and D. M. Murphy, of Rockland, have petitioned for the incorporation of a company to build an electric railway from this place to Warren.

PORTLAND, ME.—The Portland & Yarmouth Electric Ry. Co. has petitioned for authority to extend its road. Ilsley & Cummings, and T. G. Harris, of Portland, are interested.

WATERVILLE, ME.—The Waterville & Wiscasset R. R. Co. has petitioned for a charter to build an electric railway from Waterville to China, by way of Winslow and Vassalboro; capital stock, $100,000; incorporators, H. B. Goodnough, of Brighton, Mass.; Matthew Luce, of Boston; A. P. Libby, of Fort Fairfield, and I. C. Libby, of Waterville.

CANTON, MASS.—The Canton & Sharon Electric Ry. Co. has been organized with a capital stock of $50,000.

FALL RIVER, MASS.—The Globe St. Ry. Co. has petitioned for permission to extend its electric road to Tiverton. Gen. Man., R. S. Goff.

GREENFIELD, MASS.—The question of granting a franchise for an electric railway from this place to Deerfield is being discussed.

HANOVER, MASS.—The Hanover St. Ry. Co. has been granted a franchise for its electric road from Rockland to Norwell, a distance of four miles, work on which will commence as soon as the weather permits. The company will also extend its line from North Hanover to Hingham.

PALMER, MASS.—The construction of an electric railway between Palmer and Monson is being discussed. D. L. Bodfish is chairman of a committee to consider the matter.

SALEM, MASS.—It is reported that the Essex County St. Ry. Co. is to commence building its electric railway as soon as the weather permits.

SHELBURNE FALLS, MASS.—H. B. Goodenough, F. Jerrold and J. B. Libbey, of Boston, have petitioned for a franchise for an electric railway from this place to Coleraine.

SUFFIELD, MASS.—The construction of an electric railway from Springfield to this place, a distance of 10 miles, is being considered. E. K. Bodustha, of Agawam, is interested.

TEWKSBURY, MASS.—The extension of the Lowell & Suburban R. R. Co.'s electric railway to this place is being considered. Gen. Man., P. F. Sullivan.

WARREN, MASS.—It is reported that the Worcester, Leicester & Spencer Electric Ry. Co. is considering the question of extending its road from Spencer to this place. There is also talk of building electric railways to East Brookfield, Brookfield, West Brookfield and Ware.

EAST GREENWICH, R. I.—The Phenix Electric Light & Coal Co. has petitioned for a franchise for an electric railway from this place to Warwick.

PROVIDENCE, R. I.—The Old Colony St. Ry. Co. has petitioned for a charter for an electric railway from Pawtucket to some point in Massachusetts; capital stock, $250,000; incorporators, Lyman B. Goff, Henry F. Barber, M. J. Perry, Clarence L. Watson, and J. L. Sweet.

NEW HAVEN, CONN.—The New Haven St. Ry. Co. has been petitioned to extend its Lake Saltonstall electric road to Branford.

AMSTERDAM, N. Y.—It is reported that there is talk of forming a company to build an electric railway between this place and Rockton, the right of way having been secured.

BATAVIA, N. Y.—The Batavia St. Ry. Co. has been incorporated to build an electric street railway from Batavia to Horseshoe Lake, a distance of 7½ miles; capital stock, $75,000; directors, Amos H. Stevens, A. B. Wilgus, and C. C. Marsh, of New York; H. R. Burdick, of Malden, Mass.; Mark Sugarman, of Brooklyn, and F. J. Fadner, of Chicago. A. B. Wilgus, of the New York Standard Construction Co., (P. O. address, 77 Nassau St., New York), writes us that the construction of the road will be commenced about March 15.

DEPEW, N. Y.—A fund of $2,000 has been raised at Bowmansville for the purpose of having the Depew Electric Ry. extended to that village. It is said $5,000 will be raised if necessary. The work of extension will begin in a few weeks.

SALAMANCA, N. Y.—Press reports state that a company has been formed and a charter obtained for an electric road between Little Valley and this place, and extending on to Great Valley. The company expects to purchase Rock City, a place often visited by pleasure-seekers, and build a hotel there.

SYRACUSE, N. Y.—The Syracuse & East Side Ry. Co. is making arrangements to extend its electric road to South Bay and Cicero.

SOMERVILLE, N. J.—Press reports state that work has been started here on what will be, when completed, the longest electric railway in the world. The contractors are under bonds to complete by April 10 the first five miles of the New York & Philadelphia Traction Co.'s proposed electric railway between the two cities. The first rail will be laid at Raritan. It is proposed to construct a mile of track each week, and connect the towns of Somerville and Bound Brook with the city of New Brunswick. The road will run through an agricultural district, and the traction company is having built a number of combination cars to carry the products of the farms to the market.

ALLENTOWN, PA.—Press reports state that the Philadelphia Traction Co. is said to be the backer of the project to construct an electric road from Allentown to Reading, a distance of 36 miles, parallel with the East Penn branch of the Philadelphia & Reading, touching Emaus, Macungie, Alburtis, Tupton, Kutztown, Fleetwood and other places. The franchises in the rural districts have all been secured.

HARRISBURG, PA.—The Harrisburg & Cumberland Electric Ry. Co. has been incorporated with a capital stock of $36,000; Pres., Joseph J. Baughman, of New Cumberland, Pa.

HATBORO, PA.—James Nolan, of Germantown, has been awarded a contract to build an electric railway from Chestnut Hill to the convent, a distance of one mile.

HOMESTEAD, PA.—The construction of an electric railway from this place to Braddock, by way of Munhall, is being considered by Charles Jutte, and John Munhall, of Pittsburg. A survey is to be made in the spring. An iron viaduct is to be built across a hollow near Munhall.

MEDIA, PA.—An ordinance has been prepared giving the D. A. & P. E. R. R. Co. permission to extend its electric road.

NANTICOKE, PA.—The People's Ry. Co., it is reported, will soon receive bids for the construction of its electric road from this city to Glen Lyon, by way of Wanamie and Alden. The construction of the entire road is under the direction of Mr. Reid, of New York.

PHILADELPHIA, PA.—The board of surveyors has approved the plans of the Philadelphia Traction Co. for the extension of its Continental and West Philadelphia lines.

PITTSBURG, PA.—W. Smith, Fred Oesterle, and John B. Eichler are securing subscriptions for an electric railway, work on which, it is claimed, will commence as soon as the weather permits.

READING, PA.—The supervisors of Spring township, Berks county, have granted right of way to the Reading & Womelsdorf Ry. Co. for its electric road through that county.

WASHINGTON, D. C.—The East Washington Belt Line railway incorporation bill has been reported upon favorably by the House committee.

CLARKSBURG, W. VA.—It is reported that bids are wanted by the Clarksburg & Suburban Ry. Co. for building five miles of extensions and furnishing six horse cars. H. C. Gardner, Secy.

ATLANTA, GA.—The Atlanta Electric R. R. Co. has petitioned for a franchise for its line from the central part of this city to the old water-works property, a distance of several miles. Pres., Dayton Hale.

MERIDIAN, MISS.—J. F. Donovan, P. A. Brady, John F. McDermott and E. B. Tyler, of St. Louis, Mo., have secured a franchise for equipping the Meridian street railway, which they have purchased, with electricity. The road will be six miles in length, and, with new cars and other improvements, will cost about $100,000. The capital stock of the new company is $250,000.

COLUMBUS, O.—The Crosstown St. Ry. Co. has been granted a franchise to extend its electric road. Gen. Man., W. F. Kelley.

NORWOOD, O.—The electric railway is to be petitioned to extend its road on five streets.

DETROIT, MICH.—Sales Bros., of Detroit, have been awarded a contract by the Detroit St. Ry. Co. for iron poles at $30,000, and Benedict & Burnham, of Bridgeport, Conn., were awarded a contract for furnishing copper wire at $45,000. The contract for the engines will probably be awarded this week.

MANISTEE, MICH.—The Manistee, Filter City & East Lake Ry. Co., it is reported, will shortly begin the construction of a 105 × 50 ft. addition to its power house. Ch. Engr., H. O'Connell.

OWOSSO, MICH.—The Owosso & Corunna St. Ry. Co., now in the hands of a receiver, is reported as about to equip its road with electricity and extend it about two miles.

GREEN BAY, WIS.—It is reported that the Green Bay Electric St. Ry. Co. is making arrangements to extend its road to the beach, a distance of 5 miles.

MARIETTE, WIS.—It is reported that the Mariette St. Ry. Co. is to extend its electric railway in the spring to the bay shore, a distance of three miles. Gen. Man., H. C. Higgins.

BURLINGTON, IA.—E. C. Walsh has purchased from the Burlington Electric Ry. Co. its entire plant. The new management will extend the road to West Burlington, by way of Germania.

DULUTH, MINN.—It is reported that the Duluth St. Ry. Co. is preparing to extend its electric road to New Duluth, a distance of 2½ miles. Ch. Engr., M. Noble.

MARSHALLTOWN, IA.—The Iowa Soldiers' Home commissioners have granted right of way through the grounds to the Marshalltown Light, Power & Ry. Co.

YANKTON, S. DAK.—W. J. Kountz, of Allegheny, Pa., has petitioned for a franchise for an electric railway.

KANSAS CITY, MO.—The Kansas City Cable Ry. Co. is receiving bids for equipping its Kansas City & Independence dummy line with electricity, and it is expected the contracts will be awarded soon. Gen. Man., C. F. Holmes.

ST. LOUIS, MO.—The Magnolia Ave. R. R. Co. has been incorporated with a capital stock of $50,000; incorporators, Thos. J. Prosser, F. J. Flanagan, L. P. Spengler and Wm. W. Penny.

LOS ANGELES, CAL.—The Los Angeles Traction Co., recently incorporated, has secured a franchise for a crosstown electric railway. Gen. Man., Wm. S. Hook, of Jacksonville, Ill.; H. E. Storrs is interested.

SAN DIEGO, CAL.—Geo. B. Kerper, of Cincinnati, O., has purchased the San Diego Cable Ry. It is proposed to greatly improve the railway. The equipment of the road with electricity is being considered.

ELECTRIC LIGHT AND POWER.

CONCORD, N. H.—Press reports state that plans have been prepared whereby a large electric power plant will be established at Garvin's Falls, two miles below this city. There is an immense power there, which may be utilized in generating electricity to operate the electric railway at Manchester. The electric light company is also interested. The controlling interest in the Garvin Falls power is owned by W. A. Russell, of Lawrence, Mass., but the power plant would be erected by the Manchester concerns.

LE ROY, N. Y.—The Le Roy Hydraulic Electric Co. has petitioned for a franchise. Attorney, Fred. S. Randall.

SALAMANCA, N. Y.—The water-works company has petitioned the legislature for authority to supply electric light.

RIVERTON, N. J.—The citizens have voted to issue bonds for an electric light plant.

ALLEGHENY, PA.—Bids are asked until March 4 for the furnishing and erecting at the electric light station in Braddock St., of one 250-HP. and four 150-HP. vertical high-speed automatic cut-off cross compound engines. Robt. McAfee, Dir. Pub. Wks.

ASHLAND, PA.—The construction of an electric light plant is being discussed.

BELLEVUE, PA.—The Ohio Valley Electric Co. has been granted a five-year franchise to furnish 52 incandescent lights. A. J. Millar, Burgess.

SUNBURY, PA.—It is reported that East Sunbury has voted for electric lights.

FULTON, KY.—Bids are asked until March 4 for lighting this place with electricity. W. P. Nolen.

WINCHESTER, IND.—The electric light plant was destroyed by fire Feb. 16, involving a loss of $10,000.

APPLETON, WIS.—The Consolidated Water Power Co. has been formed to build a dam 1,600 ft. long and capable of generating about 7,000 HP. It is reported that work will probably begin in the summer. Peter Thom, Mayor, and T. W. Orbison, Arch., are interested.

MILWAUKEE, WIS.—Bids are asked by the board of public works until April 5 for constructing an electric light plant in the new city hall.

WEYAUWEGA, WIS.—W. H. Wood and Warren Hinchey have been granted a franchise and a contract for furnishing 12 arc lights of 2,000 c. p. at $72 per year for each light for all night service. The plant is to be in operation in six months.

FREMONT, NEB.—The council has passed an ordinance for the construction of a municipal electric light plant, which will probably cost about $18,000. The City Engineer has prepared plans, and it is likely that bids for the construction will soon be asked.

TACOMA, WASH.—Press reports state that an immense electric power house, next in size to the Niagara Falls plant, is to be built this year in the Stuck Valley, 10 miles east of Tacoma. To carry out the project, the White River Water Power Co., with a capital stock of $2,000,000, was recently incorporated in New Jersey. Water power is to be secured by tapping White River below Buckley, from which, by a simple conveyance of an open ditch, it will be carried to Lake Tappa, near Sumner, which will be utilized as a storage reservoir. The lake is three miles long, one-third of a mile wide and 100 ft. deep. From the end of the lake, by a flume over a natural grade, the water is to be diverted to the edge of the bluff overhanging Stuck Valley, giving a fall of 400 to 500 ft. to the power house, developing 25,000 HP., without counting the surplus power stored in Lake Tappa, by the use of which 50,000 HP. can be developed. It is calculated that Tacoma and Seattle can use 10,000 HP., and other towns 3,000, leaving 12,000 HP. to meet the natural growth of the two cities. An expert sent here by the Westinghouse Co. has pronounced the scheme feasible.

PENDLETON, ORE.—F. W. Vincent is preparing plans for building a 30 × 30-ft. addition to the electric light plant, putting in a new 125-HP. boiler and for increasing the number of incandescent lights to 1,500 and the arc lights to 100.

PASADENA, CAL.—The Pasadena Electric Light Co. is to increase its capital stock from $50,000 to $100,000 to enlarge its plant. Pres., J. S. Torrence.

PASO ROBLES, CAL.—The machinery of the electric light plant was totally destroyed by fire Feb. 12, according to reports.

CALDWELL, IDAHO.—Bids are asked until March 18 for the purchase of $5,000 in 6% electric light bonds. A. C. Macdonald, Cy. Clk.

NEW COMPANIES.—Chattanooga Light & Power Co., Chattanooga, Tenn.; D. J. O'Connell, F. F. Welhl.

Montgomery Electric Co., Ambler, Pa.; $1,000, with $100 paid in; Treas., W. B. Krick, Reading.

Citizens' Electric Light & Power Co., Hughesville, Pa.; $6,000, with $600 paid in; Treas., James K. Boak.

Hydro-Carbon Burner Co., Kansas City, Mo.; $100,000; to manufacture burners; Fred F. Schmidt, Wm. E. Bailie, Chas. E. Cookerly.

Hickley Launch & Electrical Mfg. Co., Asbury Park, N. J.; $100,000, with $2,000 paid in; Arthur S. Hickley, Myron S. Gould, Asbury Park; Claude V. Guerin, Ocean Grove, N. J.

Jaeger Electric Lamp Co., Newark, N. J.; $10,000, with $8,000 paid in; to manufacture electrical appliances; Herman J. Jaeger, Norman D. Webster, Brooklyn, N. Y.; Louis J. Auerbacher, Newark.

Felts Electric Light & Improvement Co., Colusa, Cal.; $1,000,000, with $100,000 paid in; to obtain patents for electrical appliances; W. W. Felts, Colusa; E. F. Peart, Geo. F. Scott, J. R. Bartholemew, Geo. B. Harden, Maxwell; W. F. Ford, U. W. Brown, Colusa.

BRIDGES.

WORCESTER, MASS.—Local papers state that the New York, New Haven & Hartford R. R. Co. will commence the construction of the new iron bridge at Elm St. as soon as the weather is more settled.

MAMARONECK, N. Y.—Justices McLoughlin and Clery, and Highway Commissioners Callahan and Slaney have been appointed a committee to secure plans and specifications for the new arch bridge noted in our issue of Feb. 14.

NEW YORK, N. Y.—We are informed that the contract for building the four piers for the East River bridge has been awarded by the New York & Long Island Construction Co. to Arthur McMullen & Co., 26 Cortlandt St., New York. The piers will 135 ft. high and contain 40,000 cu. yds. of dimension stone. Chas. M. Jacobs, 192 Broadway, is chief engineer.

PERTH AMBOY, N. J.—A bill has been introduced in the legislature authorizing Middlesex county to build a drawbridge across the Raritan River at this place.

MONONGAHELA, PA.—It is expected that the bill authorizing the Pittsburg, Monongahela & Wheeling R. R. Co. to construct a bridge across the Monongahela River at this place will be passed by the Senate this week. The House passed the bill last week.

PITTSBURG, PA.—It is stated that a bridge, about 2,000 ft. long, will be built across the Allegheny River this summer from 10th St. to Church Ave., Allegheny. The bridge will be high enough to pass over the railway tracks without grade crossings. Among those interested are William C. Jutte, August Jutte, ex-Senator Jas. W. Lee, and Senator Samuel P. White.

PITTSTON, PA.—The Scoville Island Bridge Co. has been incorporated to construct a bridge over the Susquehanna River from West Pittston to Scoville Island; capital stock, $75,000, commencing with $7,500. Treas., Evan B. Long.

BILOXI, MISS.—A bill, granting the Biloxi & Back Bay Bridge Co. the right to construct a bridge across Back Bay, has been passed by both houses of Congress.

NEW ORLEANS, LA.—The city comptroller has been directed to advertise for bids for the construction of iron bridges over the canal at Galvez St. and Hagan Ave.

NASHVILLE, TENN.—Bids are asked until March 7 for the construction of a wooden truss highway bridge on College St.; span, 150 ft.; 18-ft. roadway and 6-ft. sidewalk; bids will also be received on any other form of bridge, as stated in our advertising columns. J. A. Jowett, Cy. Engr.

ALLIANCE, O.—Press reports state that the Pennsylvania Co. will build a viaduct 1,200 ft. long over its yards at this place.

CINCINNATI, O.—It is reported that the Cincinnati & Newport Bridge Co. is to be reorganized, and the bridge to be rebuilt and enlarged.——The Main St. canal bridge has been declared in an unsafe condition, and will require immediate strengthening.

TOLEDO, O.—Bids are asked until March 27 for the substructure and a wrought iron or steel superstructure complete of a new bridge across the Maumee River, in accordance with surveys, specifications and profiles to be on file in the office of the city civil engineer on and after March 12; bidders own plans.——At a meeting of the committee on harbor, commerce and bridges, Feb. 23, the action of the committee at a previous meeting in awarding the contract for the Perry St. bridge for a lift bridge was reconsidered and the contract awarded to the Toledo Bridge Co., for its swing bridge at $29,500, roadway 38 ft., 7-ft. sidewalk on each side. L. P. Harris, Cy. Clk.

ELKHART, IND.—A press report states that the bridge over the St. Joseph River, between this city and Mishawaka, has been declared unsafe.

MENOMINEE, MICH.—It is stated that the disagreement between this city and Marinette, in regard to the bridge connecting the two cities, has been settled, and that the bridge will be repaired or rebuilt at an early date.

MUSCATINE, IA.—Bids are asked until March 19 for constructing bridges in this county during 1895. E. C. Stocker, County Audr.

OAKVILLE, IA.—It is stated that the county will build a new highway bridge with stone piers across the Iowa River one mile west of this place.

DULUTH, MINN.—The bill authorizing the Wisconsin & New Duluth Bridge Co. to construct a bridge across the St. Louis River at New Duluth has passed the House.

GALLATIN, MO.—Bids are asked until March 4 for the construction of an iron bridge, 65 ft. span, across South Big Creek. J. J. Dunn, Comr.

INDEPENDENCE, MO.—Local business men have organized a company to build suspension bridges, according to press reports. Pres., C. Lewis; Vice-Pres., L. S. Cherry; Secy., M. A. Devasher; Ch. Engr., F. C. Florence.

TEXARKANA, ARK.—The contract for the bridging for 50 miles of the Texarkana & Fort Smith R.R., noted Feb. 7, has been awarded by Monroe, Strang, Lee & Co., to McCabe & Noble, of McCabe, Mo. The contracts for grading, etc., are noted under Railways.

GEORGETOWN, TEX.—Bids will be received until March 5, according to press reports, for constructing the 11 steel bridges on the Georgetown & Granger R. R. M. P. Kelly & Co. have the contract for the entire road. Pres., Emzy Taylor.

SOUTH McALESTER, IND. T.—It is stated that the contract for the bridge timber and lumber for the Choctaw, Oklahoma & Gulf Ry., from this city to Oklahoma City, has been awarded to the Reliance Lumber Co., of Beaumont.

PRESCOTT, ARIZ.—Bids are asked until March 2 for the construction of a bridge across Granite Creek. Chas. H. Akers, Clk. Bd.

NEW WESTMINSTER, B. C.—Bids are asked until March 20 for the purchase of $120,000 of 50-year 5% bonds, being a portion of the $400,000 voted for the construction of a railway bridge over the Fraser River. D. Robson, Cy. Clk.

BELLEVILLE, ONT.—Bids are asked, according to reports, for the construction of a bridge in Hastings, north of this place; one span of 148 ft. and two spans of 100 ft., with 16-ft. roadway. Wm. R. Aylesworth, Cy. Clk.

OTTAWA, ONT.—The Carleton county bridge committee received 14 bids for the construction of the new Hurdman's bridge, the lowest being F. A. Hibbard, $3,632 and $2,762, respectively, for iron and wood, and J. Sullivan, $3,750 and $2,500.

BUILDINGS.

WATERBURY, VT. Mangson, Davis & Co., of Chicago, Ill., have been awarded the contract for constructing the additions to the state insane asylum at $89,663.

HOLYOKE, MASS.—Bids are asked in our advertising columns for the construction of a 236 × 96-ft. cotton mill, five stories in height, with 236 ft. of masonry wall foundation on canal line and cofferdam in canal 10 ft. high. Engr., F. P. Sheldon, Providence, R. I. E. Lovering, Agt. Lyman Mills, Holyoke.

BUFFALO, N. Y.—The building committee of the Ellicott Square Co. opened bids Feb. 25 for the construction of the Ellicott Square building noted last week. The members refuse to announce the figures, but say that Contractor Clark, of Chicago, was the lowest bidder. The building will cost about $2,000,000.——It is expected that work will be begun soon on the new Real Estate Exchange, for which Green & Wicks have prepared plans. It will cost $400,000.

NEW YORK, N. Y.—Plans have been filed for the following five-story brick flats: By Steinhardt & Hirsh, for three to cost $122,000; Morris Steinhardt, 648 Madison Ave., one to cost $80,000.

PITTSBURG, PA.—It is reported that the H. C. Frick Coke Co. is receiving bids for building about 200 tenement houses at its different plants in the Connellsville region.

WASHINGTON, D. C.—Press reports state that the President has signed the bills providing for public buildings at Brockton, Mass., Cumberland, Md., and Pottsville, Pa., and increasing to $200,000 the limit of cost of the Paterson, N. J., public building.

BOYDTON, VA.—It is reported that plans are wanted by the county clerk for a two-story jail building.

ATLANTA, GA.—Bids are asked until March 5 for the construction of the administration building with an auditorium for seating 5,000 people, and for remodeling the old main building at Piedmont Park for the transportation building. Arch., Bradford L. Gilbert; Grant Wilkins, Ch. of Construction; C. A. Collier, Pres. Cotton States & International Exposition Co.

CLEVELAND, O.—Bids are asked until March 12 for furnishing all material and constructing a dwelling, woodshed and boathouse for a light station at Toledo, near the mouth of the Maumee River, as stated in our advertising columns. Lieut.-Col. Jared A. Smith, U. S. Lighthouse Engr.

DETROIT, MICH.—Bids are asked by the board of education until March 13 for the construction of a school building. Archs., Malcomson & Higginbotham, Moffat Bldg.; David Wallace, Secy.

GRAND RAPIDS, WIS.—An appropriation of $15,000 has been made by the Wood county board for the construction of a jail.

DULUTH, MINN.—Bids are asked by the board of education until March 9 for the erection of a six-room addition to the Adams school building, and rubble foundation walls and superstructure for an eight-room addition to the Jackson school building. Archs., Chas. McMillen, King Block; Palmer, Hall & Hunt, Exchange Bldg.; H. W. Pearson, Clk.

PARIS, TEX.—The commissioners' court has ordered the issue of $90,000 in bonds for the erection of a court house. Plans and specifications will be advertised for at once, according to reports, after which bids for the construction will be asked.

WATER-WORKS.

LANCASTER, N. H.—The water board has voted to receive bids for $75,000 in water bonds.

LYNDONVILLE, VT.—A special village meeting was held Feb. 26 to consider plans for works, for which the village has been authorized to issue $40,000 in bonds.

LUDLOW, VT.—The $25,000 in water bonds have been sold to the National Life Insurance Co., Montpelier, Vt.

CAMBRIDGE, MASS.—Bids are asked until March 25 for the construction of 5,400 ft. of dam and roadway in the city of Waltham, as stated in our advertising columns. L. M. Hastings, Cy. Engr.

EVERETT, MASS.—Bids are asked by the water commissioners until March 8 for 1,235 lengths of 6-in. cast iron pipe.

LAWRENCE, MASS.—A contract for cast iron water pipe has been awarded to R. D. Wood & Co.

RUTLAND, MASS.—D. M. Wheeler, Chn.Com., writes us that it is not yet certain that works will be put in this season.

SWAMPSCOTT, MASS.—The question of municipal ownership is being agitated. The contract with the Marblehead Water Co. expires in October, 1897.

ALBANY, N. Y.—Judge Clute, in the Court of Sessions, has charged the Grand Jury to investigate the insufficiency of the Albany water supply.

BROOKLYN, N. Y.—The franchise of the New Utrecht Water Co. expires next year, and as the town is now a part of Brooklyn, the city is taking steps to purchase the plant.

BUFFALO, N. Y.—The board of public works, Feb. 19, opened the following bids for the construction of four boilers for use at the pumping station: Riter Bros., Buffalo, $8,061; Farrar & Trefts, Buffalo, $8,389; Watertown Steam Engine Co., Watertown, N. Y., $9,685; Oil City Boiler Works, Oil City, Pa., $9,640; A. C. Peck, Rochester, $8,550.

CASTLETON, N. Y.—Surveys for the proposed works are nearly completed. It is stated that a distributing reservoir and pumping station will not be needed.

CORNWALL, N. Y.—The question of issuing $50,000 in bonds for works will be voted upon next month, according to reports.

NEW YORK, N. Y.—Chas. F. Jordan, J. B. Bissell, D. F. Cameron, and others of this city; Jas. L. Taylor, of Dobbs Ferry, and Jas. H. Anderson, of East Yonkers, have incorporated the Upper New York City Water Co., with a capital stock of $1,000,000, to supply the town of Greenburg, Westchester county.

OLEAN, N. Y.—The commissioners have recommended the adoption of the meter system.

PAWLING, N. Y.—Bids are asked until March 30 for the construction of works, as stated in our advertising columns. Engrs., The Stanwix Engineering Co., Rome, N. Y.; Pres. Comrs., J. B. Dutcher.

SANDY HILL, N. Y.—The village trustees have contracted with the Spring Brook Water Co. to supply the village for five years, at $2,750 a year.

SAUGERTIES, N. Y.—The committee has reported that the Saugerties Water Co. has not an exclusive franchise and recommends that the village build new works; the present plant can be duplicated for about $62,000. W. F. Russell and Daniel Lamb are members of the committee.

SENECA FALLS, N. Y.—Press reports state that Rochester capitalists have purchased the works at Waterloo, and are negotiating for the plant at this place. It is proposed to consolidate the two plants and secure a supply from Seneca Lake at Waterloo. The proposed improvements would give this city much better fire protection.

TUCKAHOE, N. Y.—The town board is considering the question of granting a franchise. It is stated that several applications have been received.

CAMDEN, N. J.—A bill has been introduced in the legislature authorizing an issue of $600,000 in bonds to improve the water supply.

GLASSBORO, N. J.—The township committee has refused to sign an agreement offered by the company or to refer the question to the voters at the coming election, according to press reports. The Clayton & Glassboro Water Co. was organized to supply the two towns and had already received a contract from Clayton, but it is stated that works will not be constructed for one town alone.

JERSEY CITY, N. J.—The commissioners are reported about to lay an auxiliary main, consisting of 4,800 ft. of 12-in. and 500 ft. of 6-in. pipe, to prevent any scarcity of water in the northern section of the Heights.

ALLEGHENY, PA.—Bids are asked until March 14 for the construction of a 60-in. steel riveted conduit. It is stated that the $400,000 voted Feb. 19 was for the addition of a filter plant to the new works, for which $1,250,000 was appropriated last fall, and that the committee has been instructed by the council to advertise for bids for a system of filtration for purifying 35,000,000 gallons per day. A member of the committee is reported as making the following estimates: Three pumps (contract awarded), $177,000; conduit, $750,000; right of way, $50,000; pumping station, $300,000; leaving a balance of $373,000 for a filter plant. Robert Swan is city engineer.

BELLEVUE, PA.—At a mass meeting of the citizens Feb. 18 it was decided not to grant a franchise to the Bellevue Water Co. J. M. Simeral, Secy. Council.

MEADVILLE, PA.—The council has voted to advertise for bids for the construction of new works. Cy. Clk., W. R. Vance; Cy. Engr., W. A. Doane.

NEW HOLLAND, PA.—A company is being organized to put in works; supply from mountain springs. T. M. Storb is interested.

HANCOCK, MD.—Frank Little has offered a free site for a reservoir for proposed new works.

MOUNTAIN LAKE PARK, MD.—Hoge & White, of Wheeling, W. Va., are reported to have been engaged to make surveys and plans for works at this place.

BRISTOL, VA.—J. L. C. Smith, Cy. Clk., writes us that it is expected that the city will extend and improve the works by exending the mains to additional springs. The question has not been definitely decided.

ABBEVILLE, GA.—J. D. Lawson, Clk., writes us that the construction of the proposed works continues to be a thing of the future.

ATLANTA, GA.—Bids are asked until March 5 for laying cast iron water pipe for fire protection and water supply at Piedmont Park. Grant Wilkins, Ch. of Construction, Cotton States & International Exposition Co.

CUTHBERT, GA.—Bids are asked until March 19 for the construction of works. Robt. L. Moye, Mayor.

EUFAULA, ALA.—The legislature has passed a bill authorizing this city to build or buy works and an electric light plant.

ALGIERS, LA.—The city council of New Orleans has directed the water company to extend its mains through this place.

BROWNSVILLE, TENN.—The legislature has passed a bill authorizing this town to issue bonds for works.

LEWISBURG, TENN.—A bill has been introduced in the legislature authorizing this place to issue $2,500 in bonds for water-works purposes.

ASHLAND, O.—Bids are asked until March 5 for the purchase of $45,000 in 5% water bonds. C. G. Ducomb, Village Clk.

BARNESVILLE, O.—Bids are asked for the construction of works on the franchise plan, as stated in our advertising columns. H. E. Dement, Village Clk.

CAMBRIDGE, O.—A correspondent writes us that the city will probably spend $75,000 to $100,000 this year for water-works and sewers. Consult. Engr., C. E. Cook, of Cleveland; Cy. Engr., O. M. Hoge.

CLEVELAND, O.—The director of public works has petitioned for authority to purchase land for a new pumping station, estimated to cost about $100,000.

EVANSTON, O.—Bids are asked until March 25 for the purchase of $10,000 in 6% water bonds. W. H. Krapp, Clk.

TOLEDO, O.—A new resolution for submission to the people of the proposition to issue $150,000 in bonds for extensions has been passed by the board of aldermen.

WELLSVILLE, O.—Bids are asked until March 4 for 88 tons of 4-in. cast iron pipe, 8 hydrants, 8 valves, etc. J. W. Quinn, Supt.

WINTON PLACE, O.—Bids are asked until March 25 for the purchase of $3,000 in 6% water bonds; R. B. Page, Village Clk. The water supply for both this village and Evanston will be from the Cincinnati mains.

LANSING, MICH.—The commissioners are considering the questions of new mains for fire protection and of the adoption of the meter system.

MARLETTE, MICH.—There is talk of constructing works, owing to a recent fire.

OTSEGO, MICH.—The citizens will vote March 4 on an issue of $5,000 in bonds for extensions.

ROCHESTER, MICH.—Bids are asked until March 7 for constructing works. John F. Jackson, Village Clk.

TRENTON, MICH.—The citizens have voted,104 to 97, to issue $17,000 in bonds for municipal works.

BELLEVILLE, ILL.—The council has voted to grant a franchise to the Deep Well Water Co., to construct works in this place.

CHICAGO, ILL.—The mayor has recommended an expenditure of $276,000 for increasing the efficiency of the works.

EARLVILLE, ILL.—A press report states that the council has voted to put in works.

EDWARDSVILLE, ILL.—Jesse W. Starr, Planter's Hotel, St. Louis, writes us that the construction of works, to cost about $50,000 when completed, is about finished.

EVANSTON, ILL.—About 2½ miles of 18, 16 and 12-in. water pipe are to be laid this year. The question of erecting a new stand-pipe is being discussed.

MOUNT OLIVE, ILL.—Bids will be asked this week for constructing a $9,000 reservoir dam for the proposed works. Engr., A. E. Abend, East St. Louis.

MOUNT STERLING, ILL.—The Mount Sterling Water Co. has petitioned for a franchise. It is stated that the company will erect a stand-pipe and put in 25,000 ft. of mains; the city to put in 2,000 ft. of mains and 10 hydrants, and to pay $250 per year.

QUINCY, ILL.—The plans of Hiram Phillips, Engr., St. Louis, estimate the cost of the proposed works at $460,000. The committee is considering the plans.

BARABOO, WIS.—The franchise of the water company expires next year and the council is considering the advisability of purchasing the works, which are estimated to be worth about $100,000.

OHIPPEWA FALLS, WIS.—The council is negotiating for the purchase of the works.

MENASHA, WIS.—Bids are asked until March 5 for 1,950 ft. of 4-in. wrought iron water pipe, with hydrants, etc. W. W. Reed, Cy. Engr.

BANCROFT, IA.—Bids are asked until April 1 for the purchase of $4,200 in 6% water bonds. P. G. Pettibone, Mayor.

CALMAR, IA.—It is reported that the question of works will be voted upon at an election March 4.

FOREST CITY, IA.—J. A. Peters, Cy. Recdr., writes us that the contract for works, except stand-pipe, has been awarded to Crellin & Lovell, Des Moines, and contract for stand-pipe to Chicago Bridge & Iron Co. The city will sell $6,500 in water-works bonds in March. The total bids for the construction of the works were as follows:

O. H. Olson & Co., Stilwell, Minn.	$10,907
Iowa Construction & Mfg. Co., Sioux City, Ia.	10,800
John Ward, Audobon, Ia.	10,816
Millon & Young, Minneapolis, Minn.	10,983
Eardley, Bailey & Conner, Faribault, Minn.	11,089
Crane, Ordway & Co., St. Paul, Minn.	part of work.
Tama Foundry & Machine Wks., Tama, Ia.	part of work.
Hubbard Stone Construction Co., Sioux Falls, S.D.	10,236
Crellin & Lovell, Des Moines, Ia.	10,313
Olson & Weatherly, Marshalltown, Ia.	part of work.
Ripley-Detrick Supply Co., St. Louis, Mo.	part of work.
Chicago Bridge & Iron Co., Chicago, Ill.	11,445
Challenge Wind Mill & Feed Mill Co., Batavia, Ill.	9,687
Sykes & Wagner, Minneapolis, Minn.	9,844
B. Schriner, Des Moines, Ia.	12,700
Dean Steam Pump Co., Chicago, Ill.	on pump.
Jackson & Moss, Des Moines, Ia.	9,857
Tippett & Wood, Phillipsburg, N. J.	on stand-pipe.
Addyston Pipe & Steel Co., Cincinnati, O.	part of work.
Chapman Valve Mfg. Co.	hydrants and valves.

MUSCATINE, IA.—Bids are asked until March 19 for the construction of works for the county farm. H. C. Stocker, County Audr.

WEST BEND, IA.—The following bids have been received for contructing works:

Hubbard Stone & Contract Co., Sioux Falls, S.D.	$3,885
Jackson & Moss, Des Moines, Ia.	3,418
Crellin & Lovell, Des Moines, Ia.	3,236

MINNEAPOLIS, MINN.—Local paper state that the plans for the new reservoir will be completed so that contracts for the materials can be awarded this week.

MOORHEAD, MINN.—Jacob Kiefer writes us that no steps have yet been taken for the reported extensions.

WATERVILLE, MINN.—J. J. Morlein, Chief Fire Dept., writes us that steps will probably be taken in the near future for constructing new works; supply from well; population, 1,600.

FULTON, KAN.—At an election Feb. 18 the citizens voted to issue $7,000 in bonds for water-works and $3,000 for a city hall, construction to be commenced as soon as the new council is elected in April.

NEODESHA, KAN.—The Neodesha Water Co. has been incorporated with a capital stock of $25,000. The directors include W. I. Pierce, Adolph Bauman, Marion Cross and H. H. Arthur.

SENECA, KAN.—The city has sold $30,000 in water bonds and the construction of the proposed works will now be commenced.

BELLWOOD, NEB.—It is stated that about $300 has been subscribed for the purpose of boring an artesian well in the public square in the village.

ARGENTINE, MO.—The works and electric light plant are to be sold to satisfy a claim of $165,000, according to press reports.

HUMANSVILLE, MO.—It is stated that works will probably be built in the spring.

ST. JOSEPH, MO.—Considerable dissatisfaction is reported in regard to the present service and a committee of council has recommended that the legislature be petitioned for authority for the city to issue bonds to build or purchase the works.

JONESBORO, ARK.—O. W. Anderson, Cy. Clk., writes us that a contract for works has been awarded to Jesse W. Starr, of St. Louis, and others; population 4,000.

COLEMAN, TEX.—Bids are asked until March 11 for the construction of works, instead of March 1, as noted last week. Engr., J. S. Thatcher, Dallas; Cy. Clk., J. E. Brown.

PITTSBURG, TEX.—There is talk of constructing works and an electric light plant, according to reports.

WEATHERFORD, TEX.—It is reported probable that W. S. Faut, Receiver, will improve the works.

BALLARD, WASH.—The council is reported about to petition the city of Seattle to extend its service to this place. The West Coast Improvement Co. has a small system in use, but the supply is reported both meager and unsatisfactory.

OCEANSIDE, CAL.—The Aqua Tibia Land & Water Co. has been incorporated; capital stock, $100,000, commencing with $100; incorporators, L. H. Utt, of Redlands; Simon Goldbaum, of San Luis Ray; Joseph L. Nugent,. Henry Fisher and Herbert Crouch, of Oceanside, Cal.

CALDWELL, IDAHO.—Bids are asked until March 18 for the purchase of $13,000 in 20-year 6% water bonds; A. C. McDonald, Cy. Clk.

LEMHI AGENCY, IDAHO.—It is reported that a water company is making surveys for works, which will include a reservoir at an elevation of 125 ft. above the village.

PORT HOPE, ONT.—Bids are asked until March 20 for the purchase of $30,000 in 5% water bonds. H. V. Sanders, Town Clk.

IRRIGATION.

McCOOK, NEB.—Press reports state that work was commenced here Feb. 21 by the Lincoln Land Co. on an artesian well. The company has a complete outfit, and proposes to go 3,000 ft., if necessary, to obtain artesian water. Much interest is being taken in the project, as its success means millions for Western Nebraska.

LOVELAND, COLO.—The tunnel forming the outlet for Lake Loveland, being built for storage of water for irrigation near this place, under the direction of G. G. Anderson, is now nearly completed. It will be used for storage during the coming season.

SALT LAKE CITY, UTAH.—A correspondent writes us as follows in regard to the project of the Mount Nebo Reservoir & Canal Co., which was laid out nearly three years ago, but no work done until recently: It consists of a reservoir in Mona Valley, Juab

county, Utah, from which water will be drawn to irrigate land in Kimball Creek Valley, in Utah county. The reservoir site is about 75 miles from Salt Lake City. The outlet to the basin is Currant Creek, which cuts through the low range of mountains at the northwest corner. A dam will be built across the creek at the head of the gorge here, creating a lake 3½ miles long by one mile wide and having a capacity of 914,000,000 cu. ft. It is estimated that one year will be required to fill it. Evaporation is figured at 3 ft. per year for reservoir full. The dam site is one mile west of Mona Tank station, where the creek has cut through the igneous rock. The dam is to be 200 ft. long on top, 6 ft. wide on top and about 100 ft. at base, and will be 28 ft. high above bottom of opening and have slopes of 1½ to 1, down 10 ft., and 2 to 1 on inside for rest, and 1½ to 1 on outside, with a 3-ft. berme 10 ft. down. The material will be a mixture of sand, clay and either gravel or the cemented lava rock or volcanic ashes found on the site. The dam will be built up in layers of 6 ins., wet, harrowed and rolled, and the water side will have a 6-in. stone pavement, grouted with asphalt. The top of the dam is to be 5 ft. above high-water level. The site is to be cleared of vegetable mold, etc., and trenches will be dug along the bottom and refilled with good material. The outlet tunnel will be at west side of the dam and through rock formation. The length will be 110 ft., the width 5 ft. and the height 6 ft., with arched top. The gates will be at bottom of a shaft from highest point over middle, about 35 ft. deep by 4 × 5 ft. This outlet to be down nearly at same level as bottom of creek, and will be built first so as to divert the creek during the work on dam. On the east side of dam will be a spillway, 25 ft. wide with bottom at high-water mark. This will have a capacity of 90 cu. ft. per sec., or three times the maximum flow of the creek, and will be in solid rock. The water from reservoir will be allowed to flow in the bed of the creek for nearly 2 miles, through the gorge, when it will be diverted by a dam into a canal with a capacity of 175 sec.-ft., and carried around the head of Kimball Creek Valley, lying on the west side of Currant Creek. It is estimated that 30,000 acres will be covered by the canal, of which 15,000 will be watered, the amount being based on a supply of one acre-ft. of water to each acre per year. Fruit, beets and cereals will likely be the principal crops raised. The center of this district will be Goshen, a very old settlement on the Tintic branch of the Rio Grande Western Ry., which traverses the valley from east to west. The valley adjoins an arm of Utah Lake on south side of same. The land is mostly bench land. Work has lately been begun by the company on the outlet at dam. Gill S. Peyton is president, and O. P. Young chief engineer, both of Salt Lake City.

NEW COMPANIES.—Orchard & Alfata Irrigation Co., Cozad, Neb.; $40,000; to build a canal from the Platte River, to irrigate 15,000 acres of land; Pres., E. M. Young; Secy., E. A. Lutes; Treas., T. E. Bennison.

SEWERAGE.

MALDEN, MASS.—Bids are asked until March 7 for furnishing sewer pipe. G. A. Wetherbee, Cy. Engr.

MEDFORD, MASS.—Bids are asked until March 2 for 245,000 ft. of 18 to 4-in. sewer pipe. J. D. Sweet, Chn.; T. H. Jones, Cy. Engr.

SOUTH FRAMINGHAM, MASS.—The state board of health has approved the plan proposed for the disposal of the underdrain water connected with the sewer system. The plan provides for a reservoir and filtration area. Eighteen acres of land have been purchased in Framingham and Natick for $1,000. The sum of $13,781 has been appropriated by the town for the work, which will be commenced soon. About three months will be required to complete the job.

MERIDEN, CONN.—The committee has voted to commence the construction of the sewer extension in North Colony St. as soon as the weather permits. The average cut will be 16 ft., and 12 to 8-in. sewer pipe will be used.

NEW BRITAIN, CONN.—The council has adopted an ordinance for issuing $100,000 in bonds.

NEW HAVEN, CONN.—The committee has recommended the construction of sewers in five streets.

ROCKVILLE, CONN.—Bids are asked by the committee until March 1 for constructing a system. Engr., T. H. McKenzie, Southington.

SOUTHINGTON, CONN.—T. H. McKenzie has prepared plans for a system of 29,400 ft. of 15 to 8-in. pipe sewers, estimated to cost $80,135.

FULTON, N. Y.—The citizens will vote at the next election on the question of constructing a system.

ROCHESTER, N. Y.—The council has passed an ordinance appropriating $17,000 for a sewer in Mount Vernon Ave.

RYE, N. Y.—M. J. Hall, Health Officer of Rye Neck, has recommended the construction of 12,674 ft. of 12 to 8-in. pipe sewers, estimated to cost about $12,000.

TONAWANDA, N. Y.—The resolution to construct a system in Gastown, at a cost of $35,000, noted in our issue of Jan. 31, was defeated at a special election, Feb. 19. Engr., W. B. Landreth, Cortland.

HOBOKEN, N. J.—Bids are asked until March 13 for constructing brick sewers in two streets. M. V. McDermott, Cy. Clk.

ORANGE, N. J.—Bids are asked in our advertising columns for 19,000 ft. of 20-in., 5,000 ft. of 15-in., and 6,000 ft. of 8 to 4-in. sewer pipe. Costa & Merino, Contractors.

ALLENTOWN, PA.—Samuel Josephs, J. J. Deery and L. H. Woodrop, of Philadelphia, representing the Pennsylvania Sanitary Sewage Co., are to make a proposition to the council to construct a system.

ALTOONA, PA.—At the next election the citizens will vote on a proposition to issue $280,000 in bonds for sewage disposal.——Several pipe sewers and 2½ miles of intercepting sewers are to be constructed. Rudolph Hering, New York, has been engaged to prepare a report on a plan for sewage disposal.

ERIE, PA.—Bids are asked until March 7 for constructing 1,808 ft. of 15 and 12-in. pipe sewers. Geo. Platt, Cy. Engr.

BALTIMORE, MD.—The council is considering an ordinance appropriating $140,000 for a sewer.

WASHINGTON, D. C.—The district commissioners have ordered the construction of sewers in five streets, estimated to cost $9,310.——John Jacoby, Wilmington, Del.; G. S. Good & Co., J. P. Larguey, T. Buckley, Nallor & Brenzer have been awarded contracts for constructing sewers.

ATLANTA, GA.—David G. Wylie, Comr. Pub. Wks., informs us that the contract for constructing sewers during the year has been awarded to J. N. Hazlehurst & Co., at $33,050, and the contract for furnishing sewer pipe has been awarded to Montague & Co., at $9,125. The bids were published in our issue of Feb. 14.

TALLAHASSEE, FLA.—Bids are asked until March 19 for constructing a sewer from the court house and post office. Chas. E. Kemper, Acting Supervising Arch., Washington.

CAMBRIDGE, O.—The city will spend $75,000 to $100,000 this year for sewers and water-works. Cy. Engr., O. M. Hoge; Consult. Engr., C. E. Cooke, Cleveland.

CLEVELAND, O.—Bids are asked until March 13 for constructing sewers in six streets. J. H. Farley, Dir. Pub. Wks.

CLEVELAND, O.—Bids are asked until March 23 for the purchase of $50,000 of 4% sewer bonds. W. A. Madison, Cy. Audr.

EVANSTON, O.—Plans for a system have been prepared and submitted to the state board of health.

INDIANAPOLIS, IND.—The board of public works has ordered plans prepared for a sewer in Capitol Ave., north of Fall Creek, about one mile in length, and for a local sewer in Palmer St. Plans are also in preparation for six or eight small branches to the 14th St. sewer. Resolutions for two local sewers of 2,500 and 4,300 ft. in length will be presented this week.

RICHMOND, IND.—Bids are asked until March 15 for constructing 2,130 ft. of pipe sewers. Fred R. Charles, Asst. Cy. Engr.

KEOKUK, IA.—Bids are asked until April 1 for the construction of 920 ft. of sewer, including 550 lin. ft. in tunnel through rock, as stated in our advertising columns. W. H. Jones, Cy. Engr.

MUSCATINE, IA.—Adams Bros., of Zanesville, O., have been awarded the contract for constructing the sewers recently noted, at $15,571. The bids will probably be published next week. A. W. Yates, Cy. Engr.

MILWAUKEE, WIS.—The board of public works has prepared plans for a system in the west sewer district.

WACO, TEX.—It is reported that the system is to be greatly extended.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until March 5 for 300,000 large granite paving blocks. B. T. Wheeler, Supt. Sts.——The committee on roads and bridges in the state senate has recommended a bill authorizing the state highway commission to spend $500,000 for the construction of state highways during 1895.

PROVIDENCE, R. I.—The legislature has passed a bill authorizing this city to issue $600,000 in bonds for highway purposes.

NEW BRITAIN, CONN.—The council has voted in favor of issuing $50,000 in bonds for street improvements.

NEW HAVEN, CONN.—The chamber of commerce is discussing a proposed issue of $1,000,000 in bonds for paving.

BROOKLYN, N. Y.—The Bay Ridge shore parkway commissioners have submitted a report on the proposed driveway along the shore road from 66th St. to Fort Hamilton Ave. The estimated cost of acquiring the property embraced in the report is $2,500,000.

BUFFALO, N. Y.—Bids are asked until March 6 for constructing and repairing wooden sidewalks, furnishing oak, elm and wrought iron stakes, and for constructing hard material sidewalks for one year; also until March 14 for repairing asphalt pavements, furnishing sand for street repairs, furnishing paving blocks and for repairing roadways, etc.; R. G. Parsons, Secy. Dept. Pub. Wks.

ELMIRA, N. Y.—The council has voted to accept the act passed by the legislature authorizing the city to issue bonds for paving.

FLUSHING, N. Y.—The highway commissioners of this town and Newtown have voted to advertise for bids for repairing Strong's causeway, on the road between the two places. The work will require the handling of 55,000 cu. yds. of earth, and is estimated to cost $12,000. G. A. Roullier, Cy. Engr.

MOUNT VERNON, N. Y.—The council has appropriated $50,000 for additional asphalt paving, according to reports.

BEVERLY, N. J.—Bids are asked until March 6 for paving a portion of Cooper St., 28 ft. wide, with brick; L. Q. C. Elmer, Chn. Com.

TRENTON, N. J.—The council is taking steps to pave several streets, for which an appropriation of $30,000 will be asked, according to reports.

LOCK HAVEN, PA.—P. P. Rittman, Chn. Com., writes us that the council expects to pave several streets this year, probably with brick, but that the plans are not yet completed.

PHILADELPHIA, PA.—Local papers state that George B. Roberts, Pres. Pennsylvania R. R. Co., is at the head of a syndicate that has purchased 100 acres of land at Bala, which will be graded, paved, sewered and changed into a residence district; about $75,000 will be spent this spring.

ATLANTA, GA.—The street committee has recommended that Butler St. be paved with brick and stone blocks, at a cost of about $14,000.

ST. AUGUSTINE, FLA.—The council has been petitioned to have the shell placed on St. George St. a few weeks ago removed and the street paved with other material.

NEW ORLEANS, LA.—The city engineer is preparing plans for paving, including one street with asphalt.

LOUISVILLE, KY.—Bids are asked by the board of public works until March 16 for 5,000 tons of granite blocks.

CANTON, O.—The council has passed resolutions for paving one street with brick.

CINCINNATI, O.—Bids are asked by the board of administration until March 23 for paving Congress Ave. with brick.

CLEVELAND, O.—Bids are asked until March 13 for paving two streets and alleys with common Medina sandstone, and eight with brick, and until March 27 for paving five with dressed block Medina stone. J. H. Farley, Dir. Pub. Wks.

COLUMBUS, O.—The county commissioners have been petitioned to macadamize the Township road. W. H. Halliday, Audr.

ELYRIA, O.—The council is considering the paving of six streets, about 10,000 sq. yds. C. H. Snow, City Engr.

MARION, O.—The council has voted to issue $26,000 in bonds for the improvement of Church St. and $30,000 for the improvement of State St.——The city clerk has been directed to advertise for bids for improving one street. T. C. Bowen, City Engr.

PLEASANT RIDGE, O.—Bids are asked until March 26 for the purchase of $19,367 in bonds for the improvement of Ridge Ave. R. T. Hutton, Clk.

ZANESVILLE, O.—Ordinances have been passed for paving several streets with brick. W. M. Shinnick, Jr., Cy. Clk.

INDIANAPOLIS, IND.—Bids will be asked this week for paving South Pennsylvania St., from Maryland to South St., with brick, contract to be let about March 12. The street is 1,360 ft. long, 60 ft. wide, and has 2,625 lin. ft. of curb and 9,329 sq. yds. of surface. Plans are being prepared for paving about 9,000 ft. in Capitol Ave., and 1,300 ft. in West St., each 40 ft. wide, with asphalt.

MUNCIE, IND.—The council is reported to have voted to construct about four miles of asphalt paving this year, and it is stated that the Warren-Scharf Asphalt Paving Co. will erect a plant at this place to do the work.

RICHMOND, IND.—Bids are asked until March 15 for constructing 1,635 sq. yds. of brick sidewalk and bouldering 335 lin. ft. of alleys. Fred R. Charles, Asst. Cy. Engr.

ALPENA, MICH.—A bill has been introduced in the legislature authorizing this county to issue $100,000 in bonds for roads.

EVANSTON, ILL.—A correspondent writes us that about 2 miles of brick paving and 4 miles of cedar block paving will be constructed this year.

LA GRANGE, ILL.—Bids are asked for 40,300 sq. yds. of macadamizing, according to a press report. C. W. Northrup.

MADISON, ILL.—The council is considering several proposed street improvements.

ROCK ISLAND, ILL.—Bids are asked until March 4 for paving several alleys with brick. A. D. Huesing, Cy. Clk.

VENICE, ILL.—A correspondent writes us that street improvements are contemplated at this place.

MUSCATINE, IA.—Contracts for paving in two districts with Galesburg brick have been awarded to the Rockford Construction Co. at $37,267 and $29,001, respectively. A. W. Gates, Cy. Engr.

SEATTLE, WASH.—Efforts are being made by residents of King and Kittitas counties to have the old Snoqualmie toll road across the Cascades changed to a state road. It is estimated that the cost of the road, from North Bend through the pass to Easton, 43 miles, will be about $1,500 per mile. H. E. Taylor has made surveys for the road from North Bend to the summit and with the aid of E. P. Kendall, of the county commissioner's office of King county, has prepared a map showing the proposed route, to be sent to the legislature.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

DAM.—Appleton, Wis.—Peter Thom, Mayor, is interested in a proposed dam, 1,600 ft. long, intended to develop 7,000 HP., near this place.

WATER TOWER.—Indianapolis, Ind.—The council will probably be asked to appropriate $10,000 for a complete water tower outfit, for which plans are being considered.

WHARF WORK.—Philadelphia, Pa.—Bids are asked until March 4 for repairing the wharf property in front of the 9th Ward Gas Works. J. H. Windrim, Dir. Pub. Wks.

CHANNEL EXCAVATION.—Cleveland, O.—Bids are asked until March 6 for excavating channel at Ashtabula Harbor. Lieut.-Col. Jared A. Smith, U. S. Engr. Office.

DREDGING.—Buffalo, N. Y.—Bids are asked until March 14 for dredging Peck Slip, Buffalo River, Blackwell Canal, and Buffalo Harbor. R. G. Parsons, Secy., Bd. Pub. Wks.

DREDGING.—Boston, Mass.—Bids are asked until April 2 for dredging in the Narrows, as stated in our advertising columns. Lieut.-Col. S. M. Mansfield, U. S. Engr. Office.

DREDGING.—Cleveland, O.—Our correspondent writes us that Geo. Lockerbie, of Detroit, has decided to forfeit his bond rather than accept the contract for city dredging for five years. The bids were published last week.

PIER WORK AND TIMBER.—New York, N. Y.—Bids are asked by the department of docks until March 7 for building a new coal pier at Ward's Island; also for furnishing 388,395 ft. of sawed yellow pine timber.

POWDER.—Washington, D. C.—Bids are asked until March 11 for furnishing 150,000 lbs. of saluting powder for field guns, 50,000 lbs. to be delivered at Rock Island Arsenal, Ill., 50,000 lbs. at U. S. Powder Depot, Dover, N. J., and 50,000 lbs. at Benicia Arsenal, Cal. Brig. Gen. D. W. Flagler, Chief of Ordnance.

GAS PLANTS.—Waukegan, Ill.—It is reported that S. H. Sweet, of Chicago, and E. G. Cowdery and A. E. Smith, of the Milwaukee Gas Co., have petitioned for permission to establish a $100,000 gas plant at this place, gas to be sold for lighting purposes at $1.40 per M. cu. ft.

DREDGING PLANTS.—Bids are asked until March 26 for furnishing two dredging plants, each consisting of 1 dredge, 1 towboat, and 3 dump scows, for use on the Ohio River. Lieut.-Col. Amos Stickney, U. S. Engineer Office.

DAM.—Holyoke, Mass.—Press reports state that the Holyoke Water Power Co. has awarded the contract for constructing the dam in the Connecticut River, as advertised in Engineering News, to H. S. Hopkins and the Fruin-Bambrick Construction Co., of St. Louis. There were 27 bids received and the contract price is said to be about $600,000.

WATER POWER.—Duluth, Minn.—The Altamonte Co. has petitioned Congress for permission to purchase some 4,500 acres of land from the Indians on the Fond du Lac reservation. The company proposes to build a dam in the St. Louis near Cloquet 1,900 ft. long, 100 ft. high and 700 ft. in cross section at the base. About 25,000 acres will be overflowed and it is expected that 200,000 HP. can be developed for use in this city and vicinity. Pres., E. S. Jenison; Treas., A. C. Martin; Secy., D. H. Fletcher.

TUNNEL.—Hazleton, Pa.—Press reports state that the coal operators on the south side are now arranging to drive a tunnel through the Catawissa Mountain, which in magnitude will eclipse the Jeddo tunnel. The proposed tunnel will extend from the Switchback Ravine to Beaver Meadow, and will drain all the mines in that vicinity. The corporations interested in the project are the Lehigh & Wilkesbarre Coal Co., the Lehigh Valley Coal Co., A. S. Van Wickle, Conlock Coal Co., Silverbrook Coal Co. and several individual operators. The tunnel will be about five miles in length through the mountain. The surveys have already been made, and engineers are now engaged outlining the charts.

PARK SYSTEM.—Chicago, Ill.—Efforts are being made to establish a system of parks and boulevards on either side of the Des Plaines River from Turner Park to Riverside, a distance of about 8 miles. The suburbs in that region form almost a continuous city. —The west park commissioners have completed plans for extensive park improvements, as follows:

Humboldt Park	$261,028
Garfield Park	501,124
Douglas Park	224,448
Humboldt boulevard and extension	209,519
Douglas boulevard	190,190
Southwest boulevard	487,500
Ogden Ave. viaduct improvement	18,260
Total estimated cost	$1,892,069

It is also proposed to construct buildings in Garfield Park estimated to cost $500,000 and suitable for use for National conventions.

CONTRACT PRICES.

BRICK PAVING.—East St. Louis, Ill.—The itemized bids for improving St. Louis Ave., were published last week. The bids for the paving included 16 varieties of brick—one course of brick upon a foundation of vitrified brick laid flat, a foundation of 6 ins. elco gravel or novaculite, or a foundation of 8 ins. macadam. The property owners have voted in favor of the Wabash Poston block with brick foundation and the contract has been awarded to Francis McCabe, Union Trust Bldg., St. Louis, who has the contract for reconstructing about a mile of 8th St. (Contract Prices, Jan. 3). the two contracts aggregating over $200,000. Mr. McCabe bid $1.30, $1.26, or $1.20 per sq. yd., respectively, for one course of the Wabash Clay Co.'s brick with a foundation of brick, elco gravel or macadam. Alex. E. Abend, Cy. Engr.

Ottumwa, Ia.—A. W. Buchanan, Chn. St. Com., writes us that the contract for paving districts 12 and 49 with one course of brick upon a concrete foundation, with pitch cement filling, has been awarded to the Edwards & Walsh Construction Co., Davenport, at $1.58 per sq. yd., John S. Wolf, of Ottumwa, bidding $2.25, and Nugent & Co., of Oskaloosa, $1.65.

WOODEN CONDUIT.—Dallas, Tex.—The following bids were received Feb. 19 for constructing 15,000 ft. of 36-in. wooden stave pipe line from Elm Fort to the water-works, as advertised in Engineering News, (1) being the price per foot for the wooden pipe; (2). excavation, per cu. yd.; (3). lumber in place, per M. ft.; (4), steel bands, per lb.; (5), cast iron saddles, per lb.:

	1.	2.	3.	4.	5.
C. W. Olcott	$1.71	$0.40	$69.20	$0.02½	$0.02½
Russell & Co.	1.15	.30	50.00	.05	.05
R. K. Dabney	1.47	.33¾	45.00	.03	.05
Brownlee & Wasp[illegible]	....	.33	75.00	.03½	.03¼
Smith & Barden	1.60	.33½	.....	...	...
Chas. W. Develle	2.15	...	.....	...	...
Tufts & Strong	2.10	.28	.....	...	...
W. R. Knight	1.55	.46	48.00	.03	*.03
Sonnefield & Emmins	**1.40	.34	.....	...	...

*Wrought iron saddles, 4¼ cts.
**$1.40 to $1.55; steel sleeve, 15 cts. additional; saddle and band complete, 53 to 66 cts.

DREDGING.—Norfolk, Va.—Capt. Thos. L. Casey, U. S. Engineer Office, writes us that the only bid received Feb. 18 for dredging an inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., was that of Chester T. Caler, No. 1 Campbell's Wharf, Norfolk, Va., at 13½ cts. per cu. yd.

CEDAR BLOCKS.—Detroit, Mich.—A contract for cedar blocks has been awarded to Currie & Conn, at $7.15 per cord, the other bids being, J. D. Allen, $7.36; James Austin, $7.25; John S. Bannan (Tawas City), $7.25; John Lennane, $7.19¾. This was the third advertising during the past month. The lowest bid at the first advertising was Currie & Conn, at $8.22, and at the second advertising the lowest bid was Lennane Bros., at $7.48. Last year the city used 7,000 cords, paying $8.75 per cord, according to local papers.

SIDEWALKS.—Des Moines, Ia.—The following bids have been received for constructing sidewalks, payment to be made, according to local papers, in certificates against the improved abutting property, due in a year; prices are per square foot:

Bidder.	White Pine. cts.	Brick. cts.	Cement. cts.
E. D. Jaynes	...	9½	13¾
Steele & McDonaugh, 4 & 5 ft.	5	7	10½
Steele & McDonaugh, 6 ft.	4¾	7	10½
John Hurley & Co.	5¾	8.7	10.7
John Carey	...	...	11½
Sweitzer & Henslaw	6	...	....
Hugh Miller	...	...	13
G. B. Wicks	5½	7¾	....
B. B. Rourk	5.4	7.3	10.5
Kavanaugh & O'Connell	11½	9¾	10¾
Tim O'Brien & Co.	6¾	8½	9½
John A. Peterson, 5½ ft.	5.4	...	....
Henry C. Windsor	5¾	7¾	13¾
Bryan & Youngerman	6½	7½	11½

ASPHALT PAVING.—Niagara Falls, N. Y.—The board of public works Feb. 20 awarded to the Barber Asphalt Paving Co., of Buffalo, the contracts for paving Falls St. to Third St., 10,300 sq. yds., and Main St. to Thomas St., 6,100 sq. yds., with asphalt, at $2.87 per sq. yd. The Western Bermudez Co., of Detroit, bid $2.75, and the American Asphalt Co., of Columbus, Ohio, $2.25.

PUMPING ENGINES.—Allegheny, Pa.—The contract awarded to the Groshon High-Duty Pumping Engine Co., New York, for three 12,000,000-gallon pumping engines, was signed by the mayor this week. The contract price was $177,000, and the bids were published in our issue of Dec. 6. Robt. Swan, Cy. Engr.

REMOVING LEDGE, DREDGING, ETC.—Portland, Me.—Maj. D. P. Heap, U. S. Engineer Office, opened bids Feb. 18, for the following work: Item 1, removal of 900 cu. yds. of ledge at Moosabec Bar; 2, removal of 2,000 tons of boulders in Bagaduce River; 3, removal of 2,000 cu. yds. of ledge in Cocheco River; 4, placing 35,000 tons of stone in breakwater at Rockland Harbor; 5, similar work, 10,000 tons, Bar Harbor; 6, similar work, 10,000 tons, Saco River; 7,dredging, 60,000 cu.yds. in Camden Harbor; 8, dredging, 50,000 cu. yds., in Belfast Harbor; 9, dredging, 100,000 cu. yds. in Narraganus River; 10, dredging, 200,000 cu. yds. in Lubec Channel; 11, dredging, 30,000 cu. yds. in Harrisseekit River; 12, dredging, 80,000 cu. yds. in Little Harbor; 13, dredging 70,000 cu. yds. in Bellamy River. The itemized bids were as follows:

Townsend & Johnston, Somers Point, N. J., 1, $13.20; 2, $4.75; 3, $9.47.
Andrus W. Bryne, West Medford, Mass., 1, $14.00; 3, $6.20.
Phillip H. Doyen, Knightsville,Me., 2, $3.85; 5, 88 cts.
Joseph F. Curit, Chebeague, Me., 2, $11.00; 4, 56 cts.; 5, 78 cts.; 6, $1.25.
Geo. Willett Andrews, Biddeford, Me., 2, $3.73; 3, $7.73; 4, 77 cts.; 5, 97 cts.; 6, $1.13.
Wm. S. White, Rockland, Me., 4, 56 cts.; 6, 90 cts.
Hamilton & Cleaves, Portland, Me., 2, $10.00; 4, 65 cts.; 5, 74 cts.; 6, $1.04.
Columbian Dredging Co., Boston, 2, $4.00; 3, $7.30.
John J. Fitzpatrick, Plattsburgh, N. Y., 3, $7.73.
Robert H. Rogers, Plattsburgh, N. Y., 3, $7.15.
Columbian Dredging Co., Boston, 12, 24 cts.
Augustus R. Wright, Portland, 12, 16 cts.; 13, 34½ cts.
Moore & Wright, Portland, 8, 19 cts.; 9, 13¼ cts.; 10, 31 cts.
Hamilton & Sawyer, Chebeague, Me., 7, 19¼ cts.; 8, 14¾ cts.
Augustus B. Martin, Boston, 11, 30 cts.; 13, 29 cts.
Chas. H. Souther, Boston, 10, 46 cts.; 11, 24½ cts.; 12, 19¾ cts.
Columbia Dredging Co., Fall River, Mass., 8, 19.2 cts.; 9, 12.7 cts.; 12, 20.3 cts.

METAL MARKET PRICES.

LEAD.—New York: 3.1 to 3.12 cts. Chicago: 2.97 to 3.05 cts. St. Louis: 2.9 to 2.92 cts.

NAILS.—Pittsburg: 90 to 92 cts. for wire, and 80 to 85 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.25 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $12.50. Pittsburg: $9.75 to $10.75. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.1 to 1.5 cts.; spikes, 1.45 to 1.6 cts.; track bolts, 1.75 to 1.85 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.2 to 1.3 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $11 to $11.50 for iron, and $10 for steel; steel rails fit for relaying, $14.00; light rails, $21; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $12 to $12.50 for iron and $10 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $10 to $10.50 for iron, and $7 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.45 cts. for shell, 1.5 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 3 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.5 cts.; channels, 1.2 to 1.25 cts.; angles, 1.05 to 1.15 cts.; tees, 1.2 to 1.5 cts.; universal mill plates, 1.05 to 1.15 cts.; steel plates, 1.1 to 1.2 cts. for tank, 1.2 to 2 cts. for shell, 1.25 to 1.3 cts. for flange, 1.75 to 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.4 to 1.45 cts; channels, 1.4 to 1.45 cts.; angles, 1.3 to 1.35 cts.; tees, 1.65 to 1.7 cts., universal plates, 1.3 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.5 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

THE CARLISLE MFG. CO., of Carlisle, Pa., has a contract for freight cars for the Unadilla Valley R. R.

THE GOULDS MFG. CO., of Seneca Falls, N. Y., will build a new shop for the manufacture of its triplex pumps.

THE SHIFFLER BRIDGE CO., of Pittsburg, Pa., has the contract for a rolling mill building 60 × 112 ft. for the Sterling Steel Co.'s plant at Demmler, Pa.

WM. BELL & CO., Produce Exchange, New York, are reported as being interested in the organization of a company to establish a steel manufacturing plant at Elizabethton, N. C.

THE GOLDEN STATE MINERS' IRON WORKS, of San Francisco, Cal., has built a compound engine, with cylinders 10 × 48 and 20 × 48 ins. for a stern-wheel steamer for Alaska.

THE CONSOLIDATED BARB WIRE CO., of Lawrence, Kan., has purchased the Clark & Windsor wire mill at Joliet, Ill., and will use this as a branch factory for barb wire and wire nails.

THE JUNCTION IRON & STEEL CO., of Mingo Junction, O., has been organized as a consolidation of the Laughlin Nail Co. and Laughlin & Junction Steel Co. Pres., and Gen. Man., H. M. Priest; Secy., Geo. A. Dean.

A COTTON FACTORY with 5,000 spindles and 200 looms is proposed at Pensacola, Fla.; D. A. Tompkins, of Charlotte, N. C., S. C. Cobb, F. C. Brent and L. Hilton Green, of Pensacola, are among those interested.

THE CONNELLY GAS ENGINE CO., of New Castle, Pa., has furnished a street car equipped with a gas motor for the Second Ave. Ry., New York city. The car was built by the J. H. Vogan Car Works, of New Castle, Pa.

THE NEWTON MACHINE TOOL WORKS, of Philadelphia, Pa., is erecting a three-story shop 100 × 102 ft., which will be equipped with new machinery and a 20-ton traveling crane, and will be heated by hot air and lighted by electricity.

HALEY, CAVANAGH & CO., 451 The Rookery, Chicago, have been awarded the contract for the tracklaying to be done on the Metropolitan Elevated R. R., Chicago. This company has recently been organized by P. Haley, T. J. Cavanagh and E. G. Nourse, C. E., to carry on a general contracting business.

THE LOCOMOTIVE VALVE GEAR CO., of East St. Louis, Ill., has been incorporated by John A. Kellar, Wallace J. Lewis and Michael J. Hurley, with a capital stock of $50,000, $25,000 being paid in. This is a reorganization of the Lewis Valve Gear Co., of St. Louis, Mo., and the company is about to equip an engine for the Illinois Central R. R. The gear was illustrated in our issue of April 19, 1894.

FAIRBANKS, MORSE & CO., of Chicago, have been awarded the contract for putting in complete systems of water-works at Tolono, Ill., and Chadwick, Ill. They are also furnishing two 50,000-gallon tanks to be placed on 72-ft. towers, for the Boston & Albany R. R. at West Springfield, Mass. W. E. Bushnell is Manager of the railway contracting department, and J. A. Haskett of the water-works department.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., has the contract for an interlocking plant at the crossing of the Toledo, St. Louis & Kansas City R. R. and the St. Louis & Eastern R. R. at Alhambra, Ill. This plant is to have a novel arrangement for controlling the operator, the same as that which this company is putting in at Catlettsburg, Ky., for the Chesapeake & Ohio Ry.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has completed a truss bridge, 136 ft. long, to carry the Hartford & West Hartford Horse Ry. over the Farmington River, at Farmington, Conn. The new boiler-house designed by this company for the Stanley Rule & Level Co. has the side walls of brick, the floors of iron and the roof of iron, covered with the company's patent anti-condensation corrugated iron.

THE SCHENECTADY LOCOMOTIVE WORKS, of Schenectady, N. Y., have built two twelve-wheel or mastodon engines for the Southern Pacific Ry., to work on the Tehachapi and Sierra Nevada mountain divisions. They weigh 169,000 lbs., with 140,000 lbs. on the driving wheels, and the tenders weigh 81,000 lbs. each. The driving wheels are 4 ft. 3 ins. in diameter; cylinders, 22 × 26 ins., and the boilers are 6 ft. diameter.

THE LINK-BELT MACHINERY CO., of Chicago, has recently been awarded the contract for furnishing complete equipment, all to be operated by electricity, for a coal mine for the Essen Coal Co., of Pittsburg, Pa., including electric locomotives, breast machines, boilers, engines, etc.; contract price, $55,000. It also has a contract for furnishing a 4,000 HP. boiler to the Chicago Street Ry. Co., and for putting in new coal handling machinery in all the stations of the Chicago Gas Co.

THE BELMONT IRON WORKS, of Philadelphia, Pa., reports that during the months of December and January the volume of business was considerably larger than for many months previous. In the bridge railing department it has purchased new machinery, and greatly enlarged the facilities. The contracts cover work located in different parts of this country, and include one large lot of railing for export to South America. Among others are the following: Nine bridges in Philadelphia; three in Jersey City, N. J.; one in New Brunswick, N. J.; one in Baltimore, Md.; one large bridge near Pittsburg, Pa.; one each in Toledo, O.; Detroit, Mich.; New Orleans, La.; New Haven, Conn.; Scranton, Pa.; Troy, N. Y.; Los Angeles, Cal., and a number of other places.

NEW COMPANIES.—Keystone Equipment Co., Haddonfield, N. J.; $5,000, all paid in; railway equipment and supplies; C. Ford Stevens, Philadelphia, Pa.; John McNeill, Haddonfield, N. J.; Clarence Sell, Darby, Pa.

Diamond File Co., Cleveland, O.; $25,000; George N. Chase, Franc C. Cain and Albert H. Weed.

Velasco Construction Co., Velasco, Tex.; $10,000; John Winches, J. B. Shea and John A. Wilkens.

Gilfillan Stone Co., Rock Island, Ill.; $10,000; Wm. J. Gilfillan, Edward H. Guyer and Edward B. Kreis.

Acme Filter Co., Chicago, Ill.; $10,000; Edward Fredericks, Everett M. Holbrook and Louis G. Fredericks.

Symons Water Elevator Co., Chicago, Ill.; $145,000; Charles Loughbridge, L. McMillan and Allen E. Fowler.

Braun Automatic Scale Co., East St. Louis, Ill.; $100,000; William Braun, Robert Bethmann and Julius Baron.

Chemical Crude Oil Burner Co., Chicago, Ill.; $300,000; John L. Wiley, Charles J. Best and Henry B. Osgood.

General Construction Co., San Francisco, Cal.; $25,000, all paid in; J. F. Sims, H. C. Houghton and Wm. F. Gibson.

J. D. Hooker Co., Los Angeles, Cal.; $200,000, all paid in; boilers and machinery; J. D. Hooker, W. S. Porter and F. K. Simmonds.

Metropolitan Paving & Construction Co., Jersey City, N. J.; $50,000; Frank E. Blackwell, Astoria, N. Y., and Geo. W. S. Whitney, Orange, N. J.

Howard H. Bowen Co., San Francisco, Cal.; $50,000, with $14,700 paid in; gas and electric fittings, etc.; Howard H. Bowen, Charles A. Partridge and Carl Rector.

General Equipment & Engineering Co., Camden, N. J.; $20,000, with $1,000 paid in; Chas. W. Kremer and Edward M. Laughlin, Philadelphia, Pa.; John F. Joline, Camden, N. J.

Catskill Shale Brick & Paving Co., Jersey City, N. J.; $500,000, with $1,000 paid in; W. L. B. G. Allen, New York city; Winthrop Pond and George D. Beattys, Brooklyn, N. Y.

G. & H. Barnett Co., Philadelphia, Pa., $500,000, with $50,000 paid in; iron and steel, pipe works, foundry, etc.; Treas., Alfred W. Barnett, 1,828 Tioga St., Philadelphia, Pa.

LIST OF BOOKS ON SPECIAL SUBJECTS FOR THE USE OF ENGINEERS.

ROADS AND ROADMAKING.

A MOVE FOR BETTER ROADS: Essays on Road Making and Maintenance, and Road Laws. $2.00.

BRICK FOR STREET PAVEMENTS. By M. B. Burke. Paper. 50c.

CONSTRUCTION OF ROADS, STREETS AND PAVEMENTS. By Gen. Q. A. Gillmore. $2.00.

HIGHWAY CONSTRUCTION. By A. T. Byrne, C. E. $5.00.

MAINTENANCE OF MACADAMIZED ROADS. By T. Codrington. $2.50.

PAVEMENTS AND ROADS: Their construction and maintenance. Reprinted from Engineering Record. $5.00.

ROAD MAKING AND MAINTENANCE. By Herschel and North. New edtion; bound in stiff paper covers; price reduced from $1.50 to 50c.

ROADMAKING. By W. M. Gillespie. Full Leather. $2.50.

SANITARY ENGINEERING.

DISPOSAL OF HOUSEHOLD WASTES. By W P. Gerhard, C. E. 50c.

DRAINAGE OF HABITABLE DWELLINGS. By W. L. Beardmore. $1.50.

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